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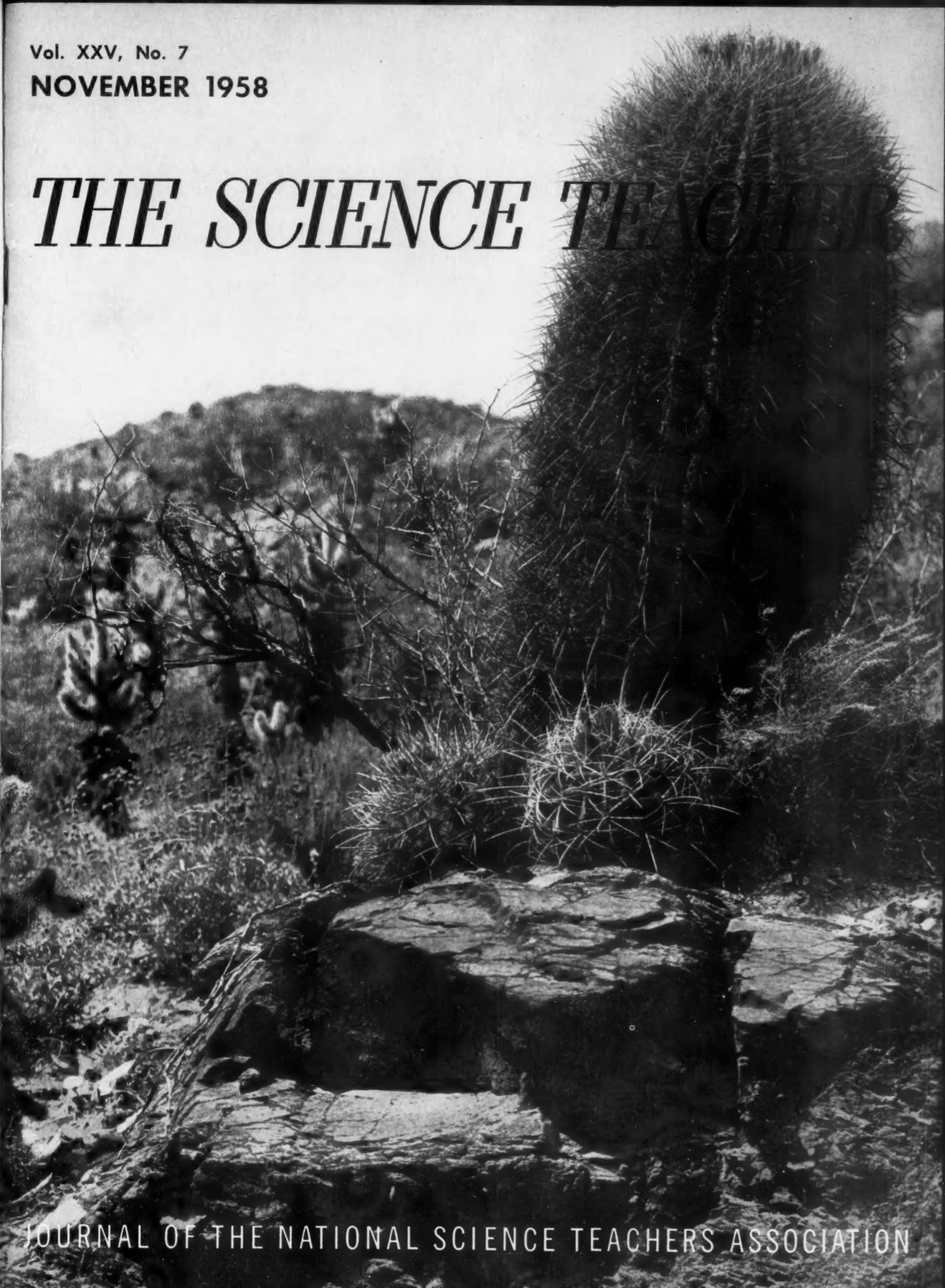
THE SCIENCE TEACHER



JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

THE SCIENCE TEACHER

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

Vol. XXV, No. 7 **November 1958**

Editor's Column

These are changing times, with the rate of change greater probably than any of us living can remember. Designs for education and procedures for teaching (even in the field of science) are not sacrosanct. Sometimes, though, I fear that we take it for granted that conventional patterns in education are exempt from the forces of change. We accept too readily, for example, that—

— the 30:1 pupil-teacher ratio is inviolable.
— the correct sequence of courses in grades 10-12 is biology, chemistry, and physics.
— that all "courses" must meet five periods per week.
— and, (You can easily add a dozen more "standard" items).

In educational fields, as in other kinds of enterprise, we need creativity, bold imagination, and bold experimentation. Happily, some of these are afoot today (though we could do with much more). Among the brightest spots in the picture are the things being tried via the media of mass communication.

Take TV, for instance.

Let's only mention in passing that several school systems and hundreds of teachers are now experimenting with the teaching of all kinds of courses by TV. Boldest adventure of all, perhaps, is the *Continental Classroom* course in modern physics. Certainly, as some cities are already saying—

— 6:30 a.m. is an "ungodly" hour to rise and "go to school."
— physics requires concentrated attention and study; it is not "easy."
— Harvey White seems unsure of his audience—is it high school physics teachers, unsophisticated, or intellectually ambitious laymen, or who?
— 160 (?) lessons require a lot of "staying" power on the part of the student-viewers.

Well, so what? Balance these negatives against the facts that the American Association of Colleges for Teacher Education (AACTE) is backing the project; dozens of colleges and universities are cooperating by offering credit for the course; half a dozen sponsors are investing hundreds of thousands of dollars in the experiment. A significant hypothesis is being tested.

Of all the comments I've heard so far, I resonate best with these remarks made by a good friend:

"By golly, I hope it's a success. There has been a precious small fraction of TV time for a truly intellectual excursion of this kind. If this one can succeed at 6:30 in the morning, the next one, whether it's science or something else, can succeed at a better time."

We might ponder on ways in which science teachers can help *Continental Classroom* succeed. Direct participation as "students" is one way; of course constructive criticism is another. Send your comments to Mrs. Dorothy Culbertson, NBC, 30 Rockefeller Plaza, New York 20, N. Y.

Kudos to NBC, Harvey White, AACTE, and the financial backers of *Continental Classroom* for this bold venture in adult education for mature adults.

Robert H. Carleton

THE SCIENCE TEACHER

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*** Includes the *Elementary School Science Bulletin* and *Tomorrow's Scientists*.**

Readers' Column

I appreciate the information you gave me on the television film, "Our Mr. Sun." I think it was very interesting and that you should encourage the Bell System to convert the film into a classroom teaching film for science.

J. Royce Flowers
Elementary Principal
Chico Public School, Texas

Last year when I was principal of the Kimball School, we obtained from you a quantity of Certificates of Achievement in Science which you offered at that time for the use of elementary schools. We found these Certificates most beneficial to the children, presenting them at our Awards Assembly to children who had done original projects. I have now transferred to the Shepherd School and am anxious to obtain some of these Certificates.

Dorothy M. Lewis
Principal, Shepherd School
Washington, D. C.

One of the problems found in a chemistry laboratory is that of getting sufficient dry test tubes for experiments. A particular experiment is one involving water of crystallization, where each student may need as many as six dry test tubes.

I have found that an ordinary hair dryer with slight modification will dry test tubes rapidly.

Harry Kuner
Abraham Lincoln High School
Philadelphia, Pa.

With every issue the journal becomes better and better. I especially enjoyed the series of articles about the Sanitary Engineering Center. And, of course, "Classroom Ideas" are always first on the reading list.

Why has the book review section been condensed? The "book briefs" are too brief—not adequately critical.

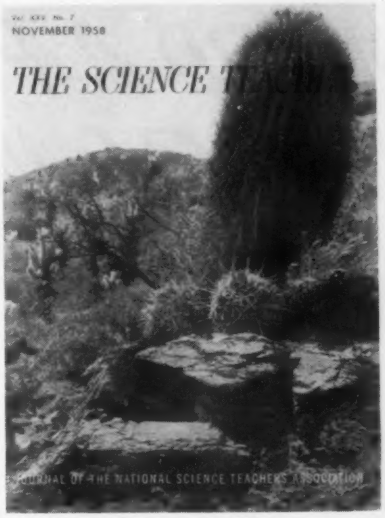
Wilfred A. Hupp
Marion-Franklin High School
Columbus, Ohio

Just a short note to say how much I appreciated receiving your fine publication "The Science Teacher" this past school year. Each issue was just like a letter from home, and I was able to keep well-posted on current happenings in my chosen field of chemistry. Especially was this so in your splendid May issue.

I am now back from Germany teaching chemistry at Whittier (California) High School.

Myron Claxton
801 S. Strub Avenue
Whittier, Calif.

THIS MONTH'S COVER . . . poses a situation in problem-solving. What interpretations or questions are stimulated by a study of this photograph? How can photographs such as this be used for interpretation of data exercises by students? Could this one be used, for example, as the basis for essay questions on the application of principles of biology? The editors will welcome correspondence from *TST* readers.



I have recently been awarded my third regional award in your program of Science Achievement Awards for Students, and I am very grateful for both the privilege of earning the honors as well as the awards themselves.

Your competition has afforded me the opportunity to delve into the fascinating field of science, and to try my hand at real research. Of lesser import but nevertheless a great stimulus are the monetary awards given to the successful participants in your program.

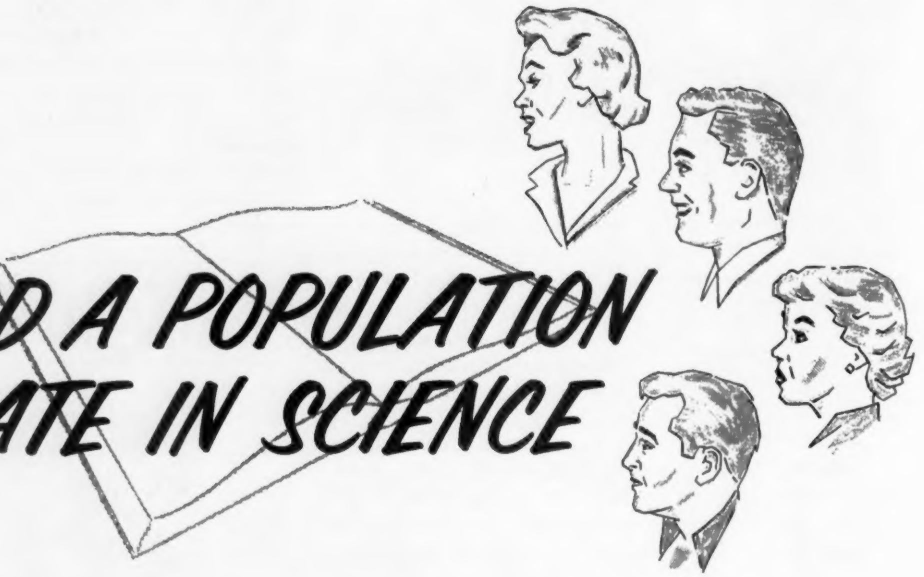
Alfred L. Goldberg (Student)
Classical High School
Providence, Rhode Island

Last June I finished my 25th year as a chemistry and physics teacher. The last 22 years in South Bend public schools and the last 18 years at John Adams High School. In the Fall of 1957 I joined the National Science Teachers Association (why I waited so long I'll never know) and I have received far more than my $6.00 would have bought many other places. Since 1933 I have also been a member of NEA, the parent organization.

Enclosed please find my application for Life Membership in NSTA.

Paul Reber
John Adams High School
South Bend 15, Indiana

TOWARD A POPULATION LITERATE IN SCIENCE



By RICHARD C. McCURDY

President, Shell Chemical Corporation

THE fabric of our democracy relies for its strength on the knowledge of the people. Up until now their knowledge—gained both from education and experience—gave them the ability to understand and appreciate the work of our scientists and technicians working in many fields.

The changes wrought by these men have primarily occurred in the realm of technology. But with many events of the last few decades, including the splitting of the atom and the consequent purposeful search into what things are and how they work, we have moved into the area of natural science very rapidly.

The change is significant, for the public appreciates the applications of physical knowledge that comprise technology, but they have much less feeling for the systematic search for greater knowledge that is the essence of natural science.

To help adapt the public to this change, I believe that it is vital to include some understanding of natural science in a broad liberal education. It will help prepare the student to participate in human and civic affairs, whatever his calling may be.

There was a time when true natural science was largely studied as an intellectual pursuit in the same manner as art, philosophy or other classical subjects. Such studies usually bore little relation to the then public interest, and exerted no major influence on public affairs. The important things of a physical nature that were taking place in those times, whether in military affairs or internally, were by and large in the realm of technology rather than science. The findings of the natural philosophers might gradually seep into technology, but the time lag was long. Few people promoted large-scale scientific study with the hope of making practical use of the results. Discoveries mainly just happened; and maybe somebody got around to make some use of them.

Gradually this time lag diminished. About the time of the First World War the discoveries of science and their practical technological applications more or less became latched together. While we continue to engage in science with intellectual objectives, the prime characteristic of the present age is that we also engage in it (on the scale of a major national effort) with the conscious purpose of using the results. This goes for basic research and investigations in fields where practical applications are more appropriate.

The profound nature and meaning of this change has escaped many people. It is one thing to make technological use of what scientific knowledge happens to be lying around, and quite another thing for a sizeable part of the population to be seeking it for the express purpose of using it one day. The difference is like that between drifting and steering a definite course.

Broadly speaking, much of the physical expansion in this country—filling its boundaries, developing its resources—occurred in the previous era and therefore was, to a considerable degree, an exercise in technology rather than in science. Getting it done successfully, therefore, mainly meant setting an atmosphere in which technology would prosper. This we did reasonably well, because, for one reason, we appreciated the benefits that accrued from these advances. We also had a fair idea of how these things were accomplished. We acquired this feeling not only in school, but outside. We could play, for instance, at damming up the Colorado River in our backyards; any convenient log might be the Brooklyn Bridge; by blowing on a kazoo we felt the workings of a phonograph; and who knew what might come out of our garage instead of Henry Ford's, or out of our bicycle shop?

In short, a rough appreciation of technology came naturally to the great bulk of our people. It is good that this happened. In a democracy it is necessary for the public at large to be in some degree acquainted with matters of national importance. I can see only trouble ahead if something of great national concern, something that should be seen as a source of inspiration and opportunity, goes unrecognized by the electorate. In such circumstances, how but by chance, can the nation decide correctly?

Fact and Fancy

What are our future prospects in the coming science-technology age? Will the general public provide the support it gave to the era of technology? If not, what can we do about it?

Our knowledge of public attitudes toward science requires much more study, but the inkling we can get today makes me uneasy. For one thing, we have semantic difficulties, an indication that many people are in the dark. While these have always been with us, today they are widespread indeed. Science is commonly confused with technology, and both of these with their tool, technique. The next step in this line of confusion identifies science with highly specialized or even vocational courses of study. And from this muddle springs the strange but prevalent idea that one gets either a scientific or a liberal education, but never both. This idea, incidentally, seems to offer the premise for two horrid alternatives, namely, that learning ceases outside the classroom—or, equally bad, that a science-oriented student cannot comprehend the humanities, or vice versa.

SHELL CHEMICAL CORPORATION

Training Classes, Anacortes, Washington

These misconceptions divorce scientists from humanity and create images of "the Egghead" and "Dr. Frankenstein." Such caricatures owe their great success to fear and suspicion of the unknown. We can—and must—portray the scientist and his work in true perspective.

How? By either giving people first-hand experience in science and mathematics, or enough second-hand knowledge to sift fact from fancy. We tell students about law and civics, literature and music, without expecting them all to become lawyers, politicians, writers or musicians. So it should be with science. In the words of the recent "Rockefeller Report" on education—"Just as we must insist that every scientist be broadly educated, so we must see to it that every educated person be literate in science."

The key word here is "literate." What breadth does it cover? Dr. Frederick Seitz, the chairman of the American Institute of Physics, classifies any insistence on extensive public education in the quantitative details of science and engineering as of doubtful value. I agree. He believes, however, that a reorientation of the popular opinion of scientists is past due, and that such reorientation will occur only by new attitudes developing in the home and secondary school. For the non-science

This article is an address delivered at Cornell University in a ceremony honoring the Shell Merit Fellowship recipients.

The Shell Chemical Corporation is representative of the growing number of business-industry organizations who recognize their dependence on a strong educational system for producers and consumers. It has provided forms of assistance through services and financial grants to help strengthen the nation's school programs. Support for a sound and thorough educational system for all individuals, workers, producers, and consumers alike, increases opportunities for continued expansion and growth for a better America in the future.

student he would, "Place primary emphasis on a continuing course in general science at the secondary school level, which gives familiarity with the history and accomplishments of science and its relation to the matters of everyday life. This should be descriptive and inspirational, placing emphasis upon the cultural roots and the goals of science and the countless ways in which it affects our understanding of the world about us." [1]

Some broad ideas that might fit in such a course concern the nature of resources and certain characteristics of research.

Most people conceive of resources—especially natural resources—as a hoard, or a treasure of various useful things, which we are gradually using up. The only evident way to increase such resources would thus be to go exploring for more of the same. Occasionally you hear dire forecasts about what will happen when the stockpiles are depleted. Such people do not realize that resources are mainly an indication of what we know, rather than of what we have.

A cave man's list of natural resources might emphasize flint pebbles, wild life, salt, water, and caves. A bronze age man would add other items, and a modern eskimo or a bushman would list his peculiar necessities. Our list differs from all of these and it, too, is gradually changing.

Each of these ages, though their lists varied, held the same attitude toward their items as we are inclined to hold today. They believed that the end of their resources meant an end to their progress, if not to the race.

I do not criticize this attitude, for our current list does represent our provisions for the near-term future. Certainly though, our current list will continue to change as research progresses. And the changes now will come faster, for we have at last entered into an age where a considerable part of our research effort is aimed at discoveries in this area.

This process of resource-creating or resource-expanding has reached a remarkable pace within our lifetime. Not long ago the rare earths were, with few exceptions, true laboratory curiosities; uranium was something that lent a nice red color to pottery glazes; transmutation of the elements occurred only in nature by some inscrutable process which might be meddled with on the most minute scale; the yield of cotton was one-third bale to the acre; a non-too-distant end could be seen to the energy stockpile; the supply of fixed nitrogen was sometimes seen as a limitation on the number of people that we could feed and clothe.

[1] Frederick Seitz. "Education for Science and Engineering." *Physics Today*, p. 15. July 1958.

The discoveries that expanded our stock of resources in these and many other fields are of extraordinary importance. Yet many people, and this includes some of the well educated, do not realize that things like this occur, and some who do, miss their significance, and thus are unaware of what sort of process causes such things to happen.

When I was a young engineer persons of national prominence claimed that we were approaching the limits of our resources, and that we could anticipate a "mature economy," a ceiling on the number of people that we could support, and a levelling off in growth of production that had come during the expansion to fill our boundaries. My purpose is not to criticize these people. They were operating on their resource list and within their set of boundaries. But I think they overlooked the greatest resource of all, the initiative and inventiveness of the people themselves. The people, fortunately, ignored the "ceilings" and soon disproved the theory.

What I do criticize, however, is a system under which a person can be unaware of such fundamental things affecting the lives of our people, and still be said to have a liberal education.

New Frontiers

This illustration suggests that there is merit in giving students the concept that mankind now has some control in guiding the nation toward new resources and thus toward new frontiers. Inherent in this concept is the question, "Toward what are we being guided?" People will ask it, and we will probably neither satisfy nor inspire them without answering it.

Our usual goals, one kind or another of physical or material betterment, are perfectly good objectives, but they suggest a pursuit after the same kinds of things we have now. To what extent this is inspiring, each can answer for himself. But to these goals I would add one more: the long term continuity of our race, coupled with, quite literally, new worlds to explore.

(Continued on page 408)

Researchers and engineers atop Martinez Refinery

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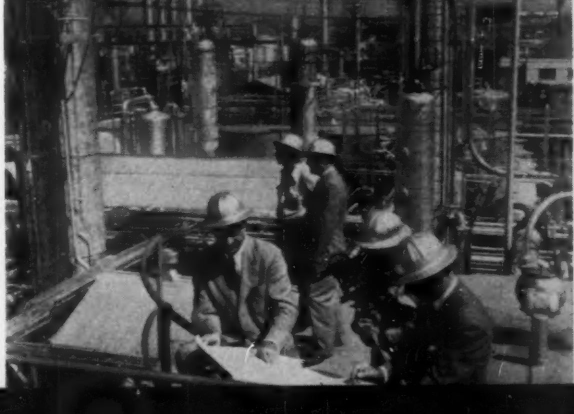


HELPING STUDENTS DEVELOP A SCIENTIFIC ATTITUDE

By ELWOOD D. HEISS

New Haven State Teachers College, Connecticut

DURING the past several decades the major goals for science education have been stated many times and in various ways. An examination of these statements reveals a unanimity of opinion that the development of a scientific attitude and the development of an understanding of, and ability to use scientific methods, are two of the major goals of science instruction. Considerable attention has been given to ways of teaching scientific methods. Much less attention has been given to the scientific attitude. This raises some doubt since a person without a scientific attitude will probably not use scientific methods. It would be easy to start an argument here similar to the old biological argument of which came first, the chicken or the egg.

The purpose of this paper is to focus attention on the development of a scientific attitude. Perhaps our greatest handicap in this area at the moment is the lack of a valid and highly reliable measuring instrument for measuring the scientific attitude. Nevertheless, it does seem possible to make several generalizations:

1. People are not born with a scientific attitude. The whole history of the human race attests to that.
2. People through proper education can, and do develop a scientific attitude.
3. People do not develop a scientific attitude by memorizing the facts, concepts and principles of science. Rather, they learn attitudes and methods by practicing them.

Numerous attempts have been made to define the scientific attitude with varying results. However, a perusal of these definitions reveals such common elements as: curiosity; freedom from bias, prejudice and superstitions; open-mindedness; critical-mindedness; intellectual honesty; belief in cause and effect; and willingness to change beliefs when new evidence is found.

The Behavior of the Teacher

As science teachers we all feel the need to teach scientific attitudes. But how shall we do it? What tactics and strategy shall we use? The following suggestions are based on the author's experiences and his many years of trial with this problem as a science teacher.

A science teacher should exhibit the characteristics of open-mindedness and intellectual honesty. His willingness to listen to others' ideas, to admit error, and dealing in an unbiased way with ideas; these make a lasting impression upon his students. In other words, the science teacher should live and act the part. The cultivation of right attitudes requires both emotional and intellectual appeal. The preservation of democratic procedures in the classroom is also a requirement. Dogmatism and authoritarianism tend to impede freedom of expression, and the exchange of challenging questions and ideas so necessary for the development of open-mindedness. In every science classroom the scientific attitude ought to be showing. Questions like these should be heard often: "How do you know that's true?" "Where is the evidence?" "Where did you find that answer?" "Can we do an experiment on that?"

A Direct Attack Upon Unfounded Beliefs

Students often have attitudes which are based upon error and misconception. Superstitions, diet fads and fallacies, astrology, patent medicines, self-doctoring, and others should be dealt with directly when the pupils reveal them. For example, many pupils believe that handling a toad will cause warts on a person's hand. What should the science teacher do in a situation like this? This is what one teacher did:

> "A lively discussion took place in one of Mr. Brown's biology classes. It all started over a live toad. Some of the students argued that one should not touch a toad because they believed warts would develop on a person's hand. Other students argued that this was only a superstitious belief. Mr. Brown suggested the following experiment to settle the argument. He suggested that the class be divided into two equal groups:
>
> An *experimental group*. Each student in this group would handle the toad.
>
> A *control group*. None of the students in this group would touch the toad."

The results of this experiment made it possible to determine whether or not certain students were willing to change their belief when evidence was produced that did not support their belief. Scientific attitude? Science teachers must be patient. The difficulty in changing naive attitudes is related to their intensity. The more highly emotionalized a student's attitude is, the greater the difficulty in changing it.

Historical and Reading Materials

In recent years more emphasis is being placed upon the use of historical materials as one means of achieving the so-called "intangible objectives" (attitudes, appreciations and methods), and rightly so. A case in point is the Harvard Case Histories, so well defined by Klopfer and Watson in the October, 1957 issue of the Science Teacher.

The emergence of science as an area of knowledge is intimately bound up with thrilling stories of privation, persecution, romance and adventure. Through the study of episodes in the history of science, it is likely that boys and girls will gain a better understanding of the attitudes, emotions, and safeguards in thinking which characterize the work of scientists, and a greater feeling of confidence in scientific methods.

A doctorate study made by Curtis, quite a while ago, presented evidence that pupils who engage in a wide reading in general science develop scientific attitudes more than those who study a single textbook. This same study showed that extensive reading of scientific literature stimulates the desire of some of the pupils to proceed further with the study of science in school. It would seem then, that science teachers should supplement the textbook with readings from suitable books and magazines. Much of the content of science can be bound up with fascinating historical and biographical incidents which make excellent material for supplementary study and reports. Many of these incidents relate how the masters of science worked, and what attitudes guided their actions.

Experience with Problem Solving

All activities suggested thus far should help pupils develop a scientific attitude and they should also help them gain a better understanding of scientific methods. But they are not enough. It is too much to hope that scientific appreciations and attitudes will become ingrained in their nervous systems by these methods alone. Above all they need to engage in projects which give them experience in problem solving. It seems rather clear now that if a pupil is to acquire skill in anything

he must have repetitive practice in that skill. Thus if he is to become a skilled problem solver with all the attitudes required for successful problem solving, he must practice them over and over again. This calls for the use of some cyclical pattern of teaching and learning.

More Controlled Experimentation

Many of the things science students are asked to do are called experiments, but too frequently they are really not experiments in the true sense of the word. They are really only exercises. And, unfortunately, sometimes students are permitted to draw conclusions from these exercises which are not proven. Here is an example. In biology during the study of transpiration the problem arises, *"Do leaves of plants give off water?"* The pupil is instructed to support a geranium leaf by a piece of cardboard with the stem extending into a glass of water. He then covers the leaf with another glass and places it in the sunlight. Eventually he notices that moisture has condensed on the inside of the upper glass, and he concludes that leaves of plants give off water. But where is the control? There is none. He should of course set up another experiment with all conditions the same, except no geranium leaf. Can he conclude then that leaves of plants give off water? Indeed not! All he can safely conclude is that the geranium leaf gave off water. In order to generalize that leaves of plants give off water it would be necessary for him to repeat the controlled experiment many times using a random sampling of leaves from the plant world.

A controlled experiment consists of two similar experiments done simultaneously with all conditions kept the same excepting one, the *variable factor*. Students should learn the skills essential to good experimenting. In so doing, they will also be practicing such things as open-mindedness, critical-mindedness, and other necessary attitudes. The average high school student is able to understand and appreciate the need for controlling all factors in an experiment except the variable factor. By the use of wise questioning and suggestions, the teacher can get students to state the purpose of an experiment, to suggest the experimental factor and to plan necessary controls to make the results sound.

Thus, to help students develop a scientific attitude, we must use every tactic and strategy at our command. We can be sure that scientific attitudes and appreciations will not arise spontaneously in some mysterious way merely by students studying the facts of science. We must teach scientific attitudes and methods directly by planning specific lessons to achieve them.

Gifted Sixth Graders Explore the Scientific World

By ELIZABETH GRAF

Pittsburgh Public Schools, Pennsylvania

IN PITTSBURGH, schools are following many different ways to guide children to use either high mental abilities or talents in special fields. Some areas seem to be "naturals" for gifted children. Science, for example, provides a field in which they can forge far ahead of their contemporaries. The Pittsburgh area—with its wealth of educators in the sciences employed by the univerisities, the Buhl Planetarium, Carnegie Institute, and the scientists employed by industry—has an unequaled reservoir of rich resources of community talents for schools to use to great advantage.

Through the Section on Instructional Services, Elementary Schools, of the Pittsburgh Public Schools, a plan was organized to make available to children some of these very valuable resources in materials and in personnel. Three years ago, during the school year 1954-55, the first group was organized. Fifteen highly gifted sixth graders from eleven schools met to form the special science group. Every child had a Binet score: the highest score 178; lowest score, 130; and the middle score, 154. In selecting the group, a high potential of learning was the prerequisite. It was felt that these science experiences would greatly benefit the children who were already pursuing science interests but would also serve to broaden the experiences of those who had no particular interest in the scientific fields. During the two suceeding years, 1955-56 and 1956-57, sixth-grade groups of comparable mental capacity were oganized. The second year, 1955-56, more members of the group had particular scientific interests. The third group, 1956-57, was still more highly selective. With few exceptions children had a keen interest in and/or knowledge about many phases of scientific learnings.

The ten visits planned for the third group, 1956-57, serve to illustrate the various group experiences. Arrangements were made to have three meetings at the Buhl Planetarium on three Saturday mornings. Saturday was necessary in order to get the services of the physicist and to have available for our own use the vast resources of the Planetarium. One meeting was spent in the Hall of the Universe. So many questions were asked about individual exhibits that finally a choice had to be made—either to satisfy the children's questions about a few exhibits or go quickly from one to the other. All of us, children included, felt that getting more complete information about a few exhibits was more important than getting a "smattering" of facts about a great many of them.

Two more Saturday mornings were spent at the Planetarium. The second week the children saw the great Zeiss projector at close range. They were told of its intricate design, the large number of mirrors, the many adjustments which could be made to flash on the dome the stars, constellations, and planets for different nights of different years as seen from many different parts of the world. They observed this marvelous projector move in and out of the Theatre of the Stars on its elevator—the only one of its kind in the world. They saw how all of the adjustments are controlled from the podium and switchboard. Then it was a fascinating experience to go inside the great dome and walk around the "catwalk." Through the many billions of tiny holes in the shell, the children could actually see into the auditorium of the Planetarium itself. As they proceeded around the dome they saw props from the various sky shows stored high overhead. The simplicity of the many effects which appeared so complicated during the finished production fascinated the children, many of whom had seen the sky shows as presented to the public. The third Saturday at the Planetarium took the children into the workshops—the carpenter shop where the blueprints for the various exhibits are prepared, the lumber cut to proportion, and the pieces assembled and painted. They observed the heating pipes, the air conditioning units, and the emergency electrical devices.

During the three visits these and other fascinating and illuminating experiences will make every visit to the Planetarium more meaningful than ever before. For these children, the Planetarium can never be quite the same again.

Five visits to the Carnegie Institute followed.

The first visit took the boys and girls to the basement laboratory of Dr. Leroy Kay, Paleontologist. Dr. Kay talked with the group, telling about the work which this particular type of scientist does in the field. Placed on a slab in the middle of the room, Dr. Kay had a large mass of the entombed bones of prehistoric animals as it had been shipped from the west. He gave each child a small mallet and a claw type pick. Boys and girls carefully scraped the accumulated dirt of the ages away from the bones. Some of the members of the group were luckier than others. They found teeth, jaw bones, and leg bones of the animals which lived in the Mesozoic age. Dr. Kay graciously gave his consent to have the children take these bones home. Well, you can imagine the excitement! "To think of getting bones at least two million years old—never before touched by the hand of any human being," "A whole Museum!" The group had two weeks with Dr. Kay. The next week the children continued to investigate the treasure-filled mass. Again they went home with bags full of bones—specimens for private collections and schools.

The third Institute visit took the group to the Department of Archeology. Here the boys and girls heard Mr. Dragoo, Archeologist, talk about the excavations which revealed the life of Indians of our district during prehistoric times. It is a thrilling story—determining where excavations may be expected to produce artifacts; carefully separating these artifacts from the soil, gravel, and sand.

Variety Tours

At the same time these visits were going on, another group of sixth graders with high potentials of learning had been having another series of tours. For one Institute visit, the group following the schedule of scientific interest and the group following the artistic interests combined. This tour took the two groups to the Carnegie Institute where Mr. and Mrs. Ottmar Von Fuehrer, Staff Artists, combined their talents to explain and demonstrate the various artistic phases of creating exhibits at the Institute. To most of the children one of the most fascinating parts of the demonstration was the making of artificial flowers having all the qualities of real flowers except life.

As a special treat for the fifth and last visit to the Institute, Mr. Richmond took us into the Herpetology Department. Here children found all kinds of specimens—preserved snakes and amphibians from all over the world, each in a glass jar and labeled to tell the exact location and date of the

SMITHSONIAN, WASHINGTON, D. C.

School Group Visits Museum

collection. Mr. Richmond had a number of live specimens and each child took a gentle, egg-eating snake in his hands. Some children had never touched a snake before. They found that snakes are not cold and clammy as they had expected.

Each week of the Institute visitations, the children were invited to lunch and had an opportunity to further question the scientist who had been in charge of the tour on that particular day. Conversations started in the laboratory were continued. This social, informal talking together at the table gave all the children opportunities to become better acquainted with Institute personnel as well as with one another.

Through the kindness of Dr. Tobias Dunkelberger, Head of the Chemistry Department at the University of Pittsburgh, the science group had an opportunity to spend a Saturday morning with teaching personnel of the Chemistry Department at the new George Hubbard Clapp Hall. The first hour, Dr. Dunkelberger talked about the elements. Of course, this topic naturally introduced uranium, atoms, protons, neutrons, and electrons—the composition, shape, and size of atoms—what is involved when fission occurs. Dr. Dunkelberger performed a few experiments to illustrate his points. His assistant took over to talk about and demonstrate "combustion" and "explosion." The high point of the morning for the children came as they went into the laboratory to conduct experiments of their own. Children were given bunsen burners and samples of elements in small tubes. Every boy and girls listed the names of the elements on a sheet of paper. After burning a small sample, the color which resulted when this element was subjected to the flame was placed beside the name of the element. As children completed the experiments with the labeled specimens, they were given mystery, numbered tubes. Each child was to determine what element was in the tube from the color produced as combustion took place.

For the tenth and last tour, the science group visited the Seventh Avenue Building of the Bell

Telephone Company. We took the elevator to the top floor and stopped for a brief explanation of each important department on each floor. Here was collected the fulfillment of many scientific research projects—the contributions of man in his efforts to improve methods of communication. Finally, we went back to the "beginnings" and into the Historical Museum where the company has collected relics of the past. As we left, each member of the group was given some illustrative printed materials which will enable all of us to recall facts.

What are the values of these tours? Many values are evident now and many will develop as the children grow older. Just now it is impossible to determine all of the values for the children cannot possibly know what influence these visits may have on their lives. These we know to be evident. Members of the group had opportunities to have contact with many sciences, some they knew only as long, fascinating words, paleontology, herpetology, geology, archeology, ornithology. The vast amount of knowledge in the world today, the many possible outlets for intellectual pursuit, the contributions of brilliant minds for the good of civilization; to all these, gifted children should have access.

All of these gifted children have read extensively, they have experimented on their own. Their curiosity and high intelligence give them deep insight into the causes and workings of problems at hand. To children of this type, these contacts with experts in the fields, even though limited, give opportunities to ask questions and discuss "man to man" some of the problems, accomplishments, and future possibilities growing out of scientific research.

It is important to note, however, that, with all this brilliant rapport, with all this deep insight, with curiosity, with creativity, with imagination, with knowledge which astonishes the experts, with questions which confound teachers, these boys and girls are just "regulars" in so many respects. They like and need to tussle with their peers, they need to "fool around a little." They want to "toss a stone into the river from the height of the pier to see the ripple."

Needless to say, the 1957-58 group was organized early in the present school year and has had three visits to the Buhl Planetarium. During the next two months they will be visiting the various departments of the Carnegie Institute. We are all having so much fun and learning so much we want these tours to continue.

Teaching Scientific Methods in Yeast Study

A LESSON PLAN

By MILTON S. LESSER

Thomas Jefferson High School, Brooklyn, New York

This report was an entry in the 1956-57 STAR (Science Teacher Achievement Recognition) awards program.

THE teaching sequence outlined below has been designed (and used with favorable results) to provide pupils with practice in the use of scientific problem solving. The subject matter is drawn from a study of yeast—structure, nutrition, and reproduction—as included in many courses of study in General Science and Biology. The approach to this study is not academic—"How does yeast reproduce?" nor "What is fermentation?" but a functional problem approach in which the pupils are guided to the statement of a problem, the proposal of possible solutions, the gathering of data and the experiences which lead to a conclusion.

While the pupil experiences are not in the realm of actual research, the sequence does provide, on the pupil's level, real experiences based on a firm apperceptive mass of familiar phenomena and materials. The problem-solving steps, shown in a fairly clear-cut fashion, are suitable for the ninth and tenth year secondary school levels.

The teaching time devoted to this small unit depends upon the ability of the class. The brighter the group, the more individual laboratory experiences permitted, the longer is the time required. It has been found that a combination of individual laboratory work, pupil and teacher demonstration, reading and discussion require at least three to four forty-five minute class periods. Where equipment and facilities are meager, the problem approach is still possible with demonstration and discussion playing a greater part. Club work and committee work after school can, of course, supplement any of the classroom experiences.

In all, the teacher transmits a minimum of information but guides the class toward maximum thinking and participation.

LESSON PLAN OUTLINE

Procedures and Key Questions	Outcomes
	(Blackboard and notebooks used throughout as the lesson progresses.)
I. Approach through identifying a quarter-pound yeast cake and eliciting its uses from experiences in the home.	I. Yeast is used in baking, brewing.
A. What is the value of having dough rise?	A. Palatability, texture, etc., are advantages of leavening.
B. What puzzles you about the rising of the dough? Pupils are guided, if necesary, to ask how or why yeast is able to make dough rise. Hear and list those suggestions which the group agrees are possible answers.	B. Possible explanations (offered by pupils): 1. A gas is produced which increases the volume. 2. Yeast reproduces rapidly to increase the volume. 3. Heat makes the dough expand. 4. All of these may be involved.
C. After some discussion, clarify the problem by asking, "What are we trying to discover?"	C. The aim, "What is there about yeast that enables it to make dough rise?" is written on the blackboard in the form suggested by the pupils. The problem is thus identified.

II. Tell the class that when a scientist finds himself in such a situation he gathers pertinent data which should help him find a solution to his immediate problem.

Ask:

A. What data do we need to discover the truth about yeast?

Refer to previous possible explanations offered and list the required data as suggested by the class.

B. How shall we gather this information?

Pupils' ingenuity may lag here.

Show fermentation tubes, prepared in advance, kept warm, with cultures as in diagram below:

dilute molasses and yeast

dilute molasses alone

Explain to the class how the culture was prepared and that the levels were the same (both filled to the top of the closed arm).

C. What differences can be observed?

D. What does the froth tell us?

E. How do conditions in both tubes differ?

III. Stimulate proposals on how to collect this gas and identify it. Refer to collection of gases in previous science work or in science books.

A. Pour dilute molasses and yeast into bottle 1. Pour lime water into bottle 2. Keep bottle 1 warm in a water bath.

B. Elicit the observation and its significance.

C. Ask pupils to criticize the statement that "the carbon dioxide came from the air in the bottle." Challenge them further by urging them to demonstrate experimentally. Clarify as necessary.

II. Listing of Data.

Data Needed

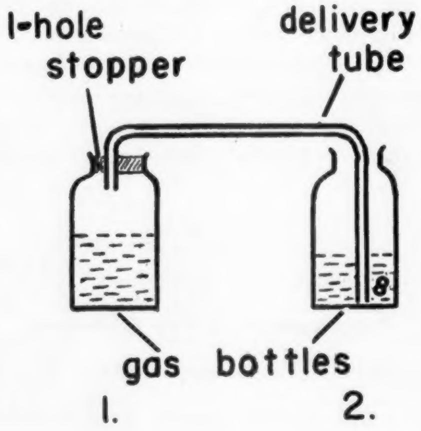
A. 1. Appearance of yeast.
   2. What is it.
   3. How yeast feeds.
   4. How it reproduces.
   5. What are its life habits?

B. Appearance—microscopic study.
   Feeding—microscopic study.
   —reference reading.
   —chemical tests.
   Reproduction—microscopic study.
   —reading.

C. In the tube with yeast, the level is lower.

D. A gas is produced.

E. One difference—yeast present in one tube; none in the other.



III. Meet with pupil committee(s) and set up several gas bottles with delivery tubes into another gas bottle thus:

A. In a little while bubbles and cloudiness appear in the lime water.

B. Carbon dioxide is present as shown by the lime water test.

C. As "controls" are suggested have the committees set up the apparatus. Provide for as many as possible, e.g., yeast with water; dilute molasses; yeast alone; water alone; air alone; warm each.

D. Allow pupils to observe and explain each demonstration, then ask:
1. What conclusions may be drawn?
2. How do we know that the carbon dioxide which appeared was not produced by the water? The air? The molasses?
3. What was the value of so many variations of the same experiment?

D. 1. Warmed yeast in dilute molasses produces carbon dioxide.
2. The other experiments did not show the presence of carbon dioxide.
3. The controls help to eliminate error and direct us to a proper conclusion.

IV. Use a wild yeast culture from the skins of crushed grapes (the yeast cells are larger and better suited for pupil observation).

A. Pupils examine wet mounts of above under low and high powers of the microscope. Iodine solution may be used for staining.

B. Pupils examine wet mounts of diluted yeast suspension in water.

C. Instruct pupils to sketch and describe a few cells from each mount.

D. Identify the structures seen. Discuss the significance of budding.

E. Discuss how long it might take to double the volume of yeast cells if reproduction occurred every half hour.

IV. Results.

A. Budding is visible.

B. "Resting" yeast cells are visible.

C. Sketches:

D. With aid of sketches, chart, model, identify:

cell wall	nucleus
cytoplasm	bud
vacuole	parent cell

E. Relate this to the rate at which dough rises in the kitchen.

V. Consider and discuss the conclusions of any experiments done by pupils with leavened and unleavened dough in warm and cool places.

V. Warmth alone is not sufficient to account for the volume difference in leavened dough.

VI. SUMMARY

A. What was our problem?

B. What data have we gathered?

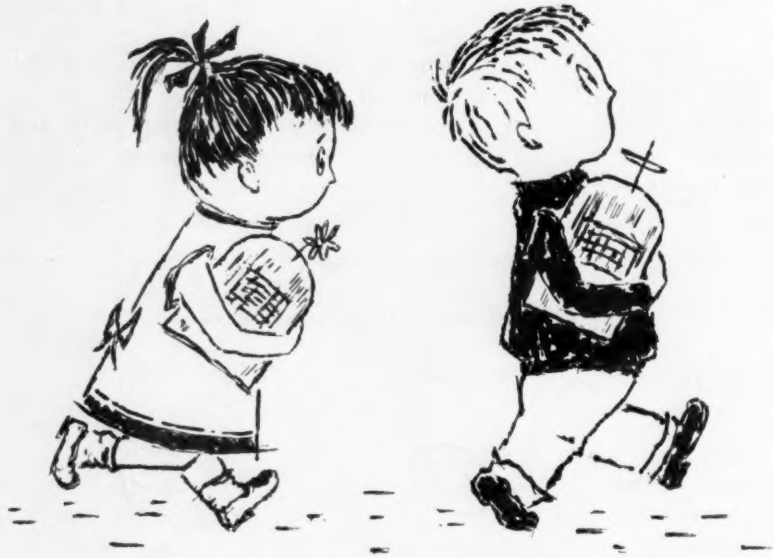
C. What can we conclude?

VI. Discussion

A. What enables yeast to make dough rise?

B. Yeast is not green. It is related fungi.
1. It is a saprophyte.
2. It utilizes carbohydrates in its metabolism.
3. Carbon dioxide and alcohol are given off by yeast.
4. Yeast reproduces by budding.
5. Warmed dough, without yeast, does not rise much.
6. Warmth is also required for the rapid budding of yeast.

C. Yeast produces carbon dioxide rapidly when it has the necessary conditions of food and warmth. The carbon dioxide bubbles make the dough rise. Heat aids the expansion of these bubbles.



VII. APPLICATIONS: (Really, in some measure, a testing of the conclusion and of understanding.) For discussion, demonstration, homework or other outgrowth activities.

A. What steps did we follow in solving our problem?
B. Why does mother object to slamming the door while bread or cake is in the oven?
C. Explain the origin of the holes in baked goods?
D. What does baking powder produce? (Wet baking powder in a gas bottle and lead a delivery tube from it into lime water.)
E. What is fermentation?
F. What is the role of fermentation in various industries?

Summary

This little unit involves at least the following elements of scientific problem solving:

Identifying a problem
Proposing solutions
Planning the gathering of data
Evaluation of the pertinence of data
Gathering the data
Careful observation
Recording of observations
Suspending judgment
Patience
Proposing controls
Using controls
Drawing conclusions
Using the conclusion to explain related phenomena

The approach and design used here, can, with some initiative and ingenuity be applied to many units in high school biology and other sciences. Through them, similar practice can be provided in problem solving. By this means an attempt can be made to habituate pupils in the use of the methods of science, a goal all of us hope to reach.

As a regular feature of *The Science Teacher*, the calendar will list meetings or events of interest to science teachers which are national or regional in scope. Send your dates to *TST's* calendar editor. Space limits listings of state and local meetings.

November 7-8, 1958: Association for the Education of Teachers in Science at Teachers College, Columbia University, New York City

November 9-15, 1958: American Education Week

November 27-29, 1958: 58th Convention, Central Association of Science and Mathematics Teachers, Indianapolis, Indiana

December 27-30, 1958: NSTA Annual Winter Meeting with science teaching societies affiliated with the American Association for the Advancement of Science, Washington, D. C.

December 28-30, 1958: 18th Christmas meeting of the National Council of Teachers of Mathematics, New York City

February 19-21, 1959: National Association for Research in Science Teaching, Atlantic City, New Jersey

February 21, 1959: Council for Elementary Science International (CESI), Atlantic City, New Jersey

February 28-March 1, 1959: CESI, Cincinnati, Ohio

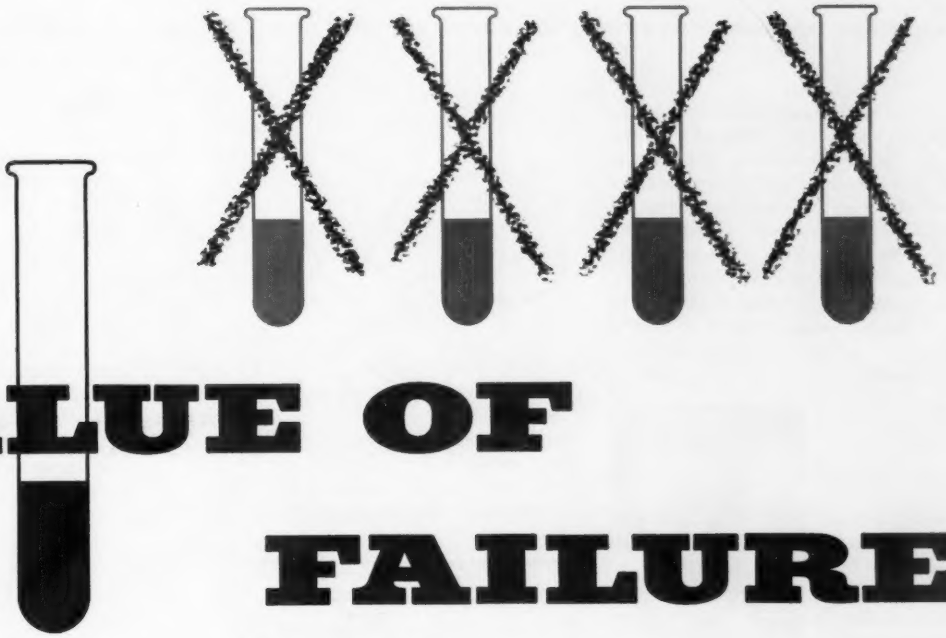
April 3-4, 1959: CESI, St. Louis, Missouri

March 31-April 3, 1959: Annual Convention, National Catholic Educational Association, Atlantic City, New Jersey

March 31-April 4, 1959: NSTA Seventh National Convention, Atlantic City, New Jersey

ASSOCIATESHIPS IN TEST DEVELOPMENT

Two Visiting Associateships in Test Development are being offered to secondary school or college teachers by the Educational Testing Service, one in Science and one in Mathematics. The appointments are for July and August, 1959. The Associates will work primarily on tests at college-entrance and higher levels. They will analyze existing tests and work on planning new ones. The stipend is $700 plus transportation to and from Princeton. Application forms due by February 27, 1959. Address inquiries to Mrs. W. Stanley Brown, Test Development Division, Educational Testing Service, 20 Nassau Street, Princeton, N. J.



VALUE OF FAILURE

By M. K. HAGE, JR.

Principal, Mathews Elementary School, Austin, Texas

HOW TO DEFINE the scientific attitude is a bit of a problem in itself. Certainly its first essential ingredient is an abiding curiosity in the way things are, and why. Children have that, of course, as the divine right of childhood. The sublime curiosity of a child making his acquaintance with the wide, wonderful world about him is a magnet with a strong pull toward our goal. But the other half of scientific attitude is the habit of staying with a point until we find the answer. Curiosity unsatisfied can lead to baffling frustration; but the formation of habits of investigating and perseverance in the pursuit of answers is the best educational gift a child may receive. For one thing, it is an antidote to the charming but immature daydreaming common to many school-age children—maybe to yours? With all its charm, daydreaming is a luxury they must cast off—lest they become a generation of little Walter Mittys. This imaginative way of seeing things as they ought to be, for their own convenience and gratification, is just the opposite of the viewpoint of science in seeing things as they are and not necessarily as they ought to be.

And yet, these unrelated opposites may grow into a constructive relation. When the child's curiosity becomes an active quest for the way things are related to him individually, he has the basis for his problem. When his daydreams are crystallized into objectives that might become realities, he has a problem from another source. If his essays into science have taught him first that all things are interrelated and most of them may be interrelated with his well-being, and second that there are ways to seek out most answers, then the scientific approach to problem solving is at work. And steady and regular training in these habits can serve him almost as automatically as his opposite thumb—which is supposed to be one of man's greatest physical advantages. Louis Agassiz and his two-months test of a would-be Agassiz story disciple may well exemplify the point. The story of this Swiss scientist who became one of Harvard's most distinguished teachers, and widely quoted in a schoolreaders series a generation ago, tells how he gave the ambitious young man a gallon jar of bones and left him to his own devices to find what he could about them. Fortunately, the lad was scientist enough to begin sorting the bones and to discover them to be fish bones. The jaws quickly gave him the cue that they were from a variety of fishes. Within two months he had succeeded in reconstructing all the skeletons and had earned a master's acceptance of him as an understudy. The obvious moral is that most of the experiences of life are to some people as confusing and baffling as a jar of assorted fish bones.

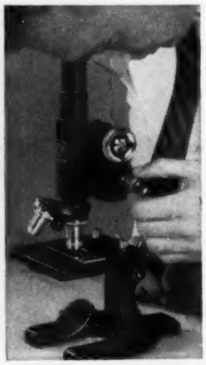
Not all the jars of bones match out in real life, though—and the student has to be prepared for this dead-end research before he has captured the real scientific attitude. Scientists, of course, do

AO Reports on Teaching with the Microscope

Sanguinary explorations among the monocytes and neutrophiles... or narcism in the classroom.

Someone of sublime wisdom (Schopenhauer, we think) once said that, "things in general become absorbingly interesting when related specifically to ourselves". With this in mind we herein offer a teaching experiment on the observation of red and white blood cells which provides an elementary excursion into the mysteries of the human blood stream.

The basic technique given here for obtaining blood and making stained smears is used by trained clinical laboratory technicians and physicians seeking vital diagnostic information. Used in your classroom, it can bring real drama as your students study their own blood.



You'll need good microscopes for this experiment... scopes with the qualities of a professional clinical laboratory instrument. Our 66 series microscope, with excellent image quality, precise fine adjustment and ruggedness, is ideal.

If your lab is equipped with these microscopes (as countless school labs are) you're all set. If not, and if you want information about them, just write to Dept. 000, American Optical Company, Instrument Division, Buffalo 15, New York and ask for Brochure SBTI-458.

EXPERIMENT

Observation of Red and White Blood Cells

MATERIALS AND PREPARATIONS

Blood lancet or sharp needle; 2" x 2" gauze squares; 70% alcohol; microscope slides and cover glasses; vaseline; Wright's Stain (inexpensively obtainable as a ready-to-use solution from any laboratory supply house); distilled water; normal saline; medicine dropper; AO Spencer No. 66 compound microscope equipped with 10X, 43X objectives and 10X eyepiece (oil immersion 97X objective would be ideal).

Set up microscope; clean several slides with acetone and polish dry with clean cloth; rim a cover glass with vaseline; sterilize lancet or needle over flame and place in 70% alcohol.

PROCEDURE

1. Scrub middle finger of willing student "patient" with gauze soaked in 70% alcohol. Wipe dry. Grasp finger between thumb and index finger and squeeze down toward tip; a slight prick with a needle or lancet will yield abundant blood which should form in firm drops if finger is absolutely dry. (Fig. A)

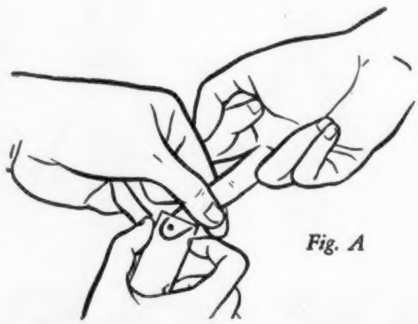


Fig. A

2. Place drop of blood on end of one slide and touch end of second slide to it (see Fig. B) at an acute angle... push second slide over first to make thin blood smear. Make several slides and allow to dry.

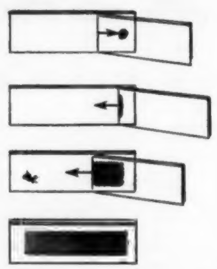


Fig. B

a. *Observation of whole red blood cells:* While smears are drying, place another drop of blood on clean slide... add drop of normal saline and place vaseline rimmed cover glass over mixture. Press until thin film forms and vaseline makes air-tight seal. Observe under 10X and then 43X... whole red blood cells can be seen suspended in the plasma-saline solution. (Fig. C)

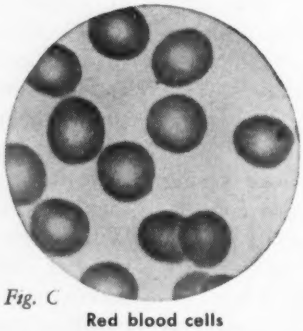


Fig. C

Red blood cells

b. *Differential staining of white blood cells:* Place dry smear on rubber stopper (stain in sink or disposable catch pan, i.e. made of aluminum foil). With dropper, cover slide with 30 drops of Wright's stain, allow to fix for 1 minute... add 30 drops of distilled water. Blow gently on mixture until metallic film forms. Let stand 4-5 minutes, then flood stain off with tap water. Blot dry and observe under microscope. Locate thin edge of smear with 10X and then switch to 43X (oil immersion, 97X is preferable). Red blood cells will appear a faded pink or orange color. The different kinds of white blood cells will be stained in varying shades of purplish-blue and eosin, a yellowish-orange color; pebbly clumps of platelets (necessary factor in blood-clotting) will be stained a pale blue. (Fig. D) Under oil immersion, and even under 43X, the various white blood cells can be easily differentiated as polymorphonuclears, segmented neutrophiles, monocytes, etc., by differences in nuclei, cell sizes and staining characteristics. (See Kracke and Garver: *Diseases of the Blood and Atlas of Hematology* for color plates of actual white blood cells differentially stained).

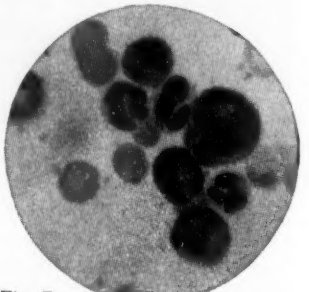


Fig. D

White blood cells from stained smear

c. *Importance of differential white blood counts:* During the course of a disease, the total white blood cell count increases or decreases. However, the doctor must also know the *type* of cell involved. For example, a high white blood cell count with a preponderance of lymphocytes indicates the possibility of mumps, whooping cough, German measles or leukemia. A large number of neutrophilic cells indicates possible rheumatic fever, localized acute infection, or scarlet fever.

OBJECTIVES: This elementary hematological experiment achieves these science objectives: a fund of knowledge about the human body and the physiology of blood; skill in the use of the compound microscope and an appreciation of its application to medicine; clinical laboratory techniques and their diagnostic importance.

SCIENCE TEACHERS! $25 For Your Experiment

Here's a chance to share your ideas with other teachers. We will pay $25.00 for each experiment involving either laboratory or stereoscopic microscopes accepted by us for future ads like this one. We're looking for unusual experiments suitable for the high school and junior college level. Don't worry about the form, or illustrations, just give us all the pertinent information. In the event of similar experiments the one bearing the earliest post-mark will be used. See your name in print... write in now!

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much more than wear Van Dyke beards and white coats and testify to the relative merits of tooth powders on TV screens. They even do more than develop thermonuclear weapons that could put our globe out of business. These dedicated researchers are quick to say that they spend most of their time finding out what cannot be done with the materials of our earth than what can be done. That is, most of their results are negative; they have to turn up a thousand duds before finding the one thing that works. Therein lies a lesson that has to be learned sooner or later—in science classes or in life.

Not that we're advocating courses in disillusionment! But we do contend that science teaches an exceedingly important concept if it helps the child learn early that the VALUE OF FAILURE is that it is a STEPPING-STONE TO SUCCESS. So treated, error becomes one of the better parts of wisdom. Better than the spider taught Robert Bruce, it drives home the lesson that perseverance is a better long-run companion than luck. Our children need an antidote for the unreal worlds of movies and TV, wherein ideas are perhaps too neatly packaged—where success is on the side of sweetness and light and the villain is punished in the final reel or just before the commercial. With widening horizons, our children need to develop courageous faith in ultimate group success—the achievements of class, school, community, city, state, nation, and ultimately of many nations in accord. The stories of persons working in science can help. For every scientist with the serenity of an Edison, there are a hundred who never reach a single final answer to a problem. But if their failures speed the way to success of a team or group, an important contribution is made.

Educational Services through Radio

"The World of the Mind," a new radio series, written by more than 50 outstanding American scientists and teachers, was announced by Broadcast Music, Inc., of New York. The programs were prepared in cooperation with the American Association for the Advancement of Science and the American Council of Learned Societies. The material is available without charge by BMI to all radio and television stations and to public libraries and local boards of education for their broadcasting activities.

Among the programs of interest to science teachers are: *The Sun, Origin and Evolution of the Stars, The Milky Way, Chemistry of Nutrition, Atomic Radiation and Hereditary Effects, Solar Energy, and Chemistry of the Future.* Additional information on these topics, and also on non-science topics in the series, may be obtained by writing to Broadcast Music, Inc., 589 Fifth Ave., N. Y., or write your local radio station.

School-Community Activities for the Improvement of Science Teaching

By BENJAMIN J. NOVAK

Frankford High School, Philadelphia, Pennsylvania

IMPORTANT EFFORTS on a national scale are being made for the improvement of science instruction. The federally-supported National Science Foundation is enlarging its summer and academic year institutes for science teachers at many universities throughout the country. The Westinghouse Corporation is well known for its annual high school talent search, now more than 18 years old, and for its teacher institutes. The American Chemical Society and other scientific and technical associations have committees carrying out nationwide programs. Many industries and foundations sponsor summer employment for science teachers, support institutes for teachers at universities, contribute millions of dollars for collegiate research, and make possible numerous college scholarships for young people pursuing scientific careers. Printed teaching aids, career information, and other free materials supplied by industry and professional groups are voluminous and readily available.

Many localities are amplifying and improving their science instruction by their own efforts in ingenious ways. The nature and organization of these efforts vary from community to community, but there are many ideas worth examining. The initiative and leadership may come from a local school superintendent, curriculum specialist, science supervisor, science teachers association, science museum, university, scientific association, individual scientists, or industry. Whatever the original impetus, most of the above named become involved sooner or later. Small communities do not feel barred by size from successful effort.

In most localities the various contributing persons and groups function rather informally with the schools. Some communities, however, are more effectively organized. Much is to be gained from coordinated, rather than independent action. Experience has shown that well-meaning, but uncorrelated efforts by outside groups can cause duplication, waste of effort, and a working at cross purposes. The school has the burden of sifting through many ideas of uneven merit, and in rejecting any of them, runs the risk of being thought ungrateful or indifferent. Advertising and other vested interests must not invade the school's impartiality, although altruism is generally the rule. In short, a clearing house can be of inestimable value. Philadelphia, for example, formed in 1946 the *Philadelphia Science Council,* with school, college, and industrial personnel from the metropolitan area. Contributions from local industry have built up a modest treasury, and the Council was incorporated in 1953.

Early organization insures better progress. The executive committee meets once each month, under the leadership of a president elected for a two-year term. In the Washington, D. C., area, a Joint Board for Science Education was established early in 1956. It comprises representatives from some 25 societies affiliated with the Washington Academy of Sciences, and 25 engineering groups comprising the D. C. Council of Engineering and Architectural Societies. This joint board of ten persons coordinates the activities of these societies with the school. Indianapolis, Indiana, has an Industry-Schools Committee on Science and Mathematics Education, while Baltimore, Maryland, is organizing an over-all science council of industrial, high school, collegiate and professional representatives. Pitman, New Jersey High School has a citizens' committee of scientists organized recently to aid in improving the school's science instruction.

You Can Depend on the GENATRON

● *The MODERN Electrostatic Generator*

THE CAMBOSCO GENATRON serves not only for classical experiments in static electricity, but also for new and dramatic demonstrations that are not performable by any other means. It exemplifies a modern method of building up the tremendously high voltages required for atomic fission, for nuclear research, and for radiation therapy.

Entirely self-exciting the GENATRON cracks into action at the snap of the switch—whose only function is that of starting the motor drive. No auxiliary charging method is employed. Hence, despite an output measured in hundreds of thousands of volts, no hazard is involved, for the operator or for the observers.

An Output of 250,000 Volts—or More!

THE CAMBOSCO GENATRON is designed to deliver, in normal operation, a discharge of the order of 250,000 volts. That figure, a conservative rating, is based on many trials conducted under average conditions. With ideal conditions, a potential difference of 400,000 volts has been achieved.

Modern Design— Sturdy construction and ever-dependable performance distinguish the GENATRON from all electrostatic devices hitherto available for demonstration work in Physics. This powerful, high-potential source, reflecting the benefits of extensive experience in electrostatic engineering, has absolutely nothing but purpose in common with the old-fashioned static machine!

NO FRAGILE PARTS—Durability was a prime consideration in the design of the GENATRON which, with the exception of insulating members, is constructed entirely of metal.

The only part subject to deterioration is the charge-carrying belt, which is readily replaceable.

NO TRANSFER BODIES—In all conventional influence machines, whether of Holtz or Wimshurst type, electrical charges are collected and conveyed (from rotating plates to electrodes) by a system of "transfer bodies." Such bodies have always taken the form of metal brushes, rods, button disks or segments—each of which, inevitably, permits leakage of the very charge it is intended to carry, and thereby sharply limits the maximum output voltage.

It is a distinguishing difference of the GENATRON that electrical charges, conveyed by a non-metallic material, are established *directly upon the discharge terminal.* The attainable voltage accordingly depends only upon the geometry of that terminal and the dielectric strength of the medium by which it is surrounded.

Unique Features of the CamboscO Genatron

DISCHARGE TERMINAL Charges accumulate on, and discharge takes place from, the outer surface of a polished metal "sphere"—or, more accurately, an oblate spheroid.

The upper hemisphere is flattened at the pole to afford a horizontal support for such static accessories as must be insulated from ground. A built-in jack, at the center of that horizontal area, accepts a standard banana plug. Connections may thus be made to accessories located at a distance from the GENATRON.

CHARGE-CARRYING BELT To the terminal, charges are conveyed by an endless band of pure, live latex—a CamboscO development which has none of the shortcomings inherent in a belt with an overlap joint.

DISCHARGE BALL High voltage demonstrations often require a "spark gap" whose width can be varied without immobilizing either of the operator's hands.

That problem is ingeniously solved in the GENATRON, by mounting the discharge ball on a flexible shaft, which maintains any shape into which it is bent. Thus the discharge ball may be positioned at any desired distance (over a sixteen-inch range) from the discharge terminal.

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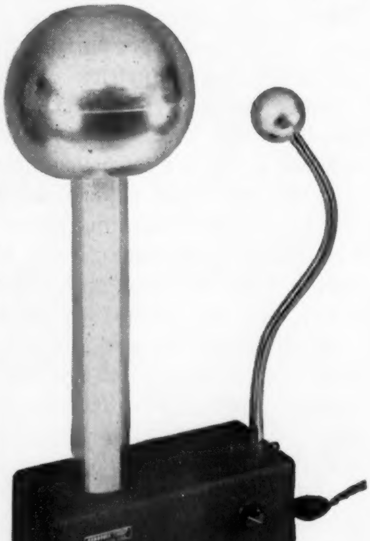

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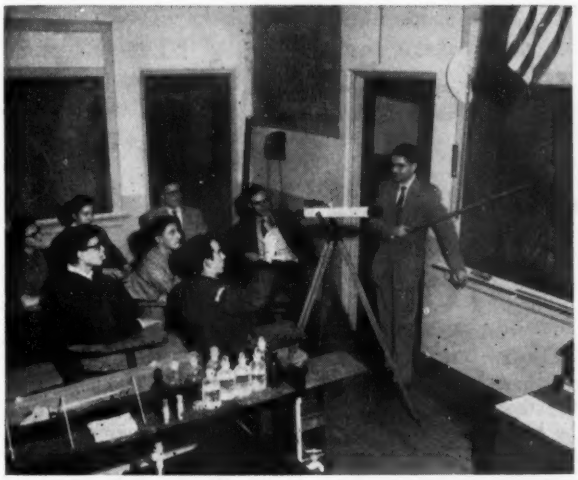

Evening Seminar by local scientists in Astronomy, Roger Ludlowe High School, Fairfield, Conn. (Dr. Leonard Flom at blackboard and Dr. Gordon Jonas near phone.)

Special Learning Activities

Among noteworthy local projects for broadening the curriculum is special instruction for the gifted in science, or related fields.

The Philadelphia Science Council arranges each spring advanced science activities for selected high school students. Meetings held on Saturday morning or after school usually include four two-hour sessions. In the spring of 1958, nine activity groups were scheduled, at Drexel Institute of Technology, the Philadelphia College of Pharmacy and Science, Temple University, and the University of Pennsylvania. Areas of concentration included: geology, chemistry, botany, optics, electronics, metallurgy, physics, and chemical engineering. More than one student and parent has testified that these activities have been determining factors regarding a career in science fields.

Fairfield, Connecticut, has a science advisory committee of local scientists assisting the schools in expanding and upgrading their science program. Among the developments in the spring of 1958 was the establishment of student interest groups meeting in the schools for two hours each Thursday evening, under the direction of industrial and collegiate engineers. Sixty students were divided into five groups in these areas: astronomy and biology, electronics and radio, nuclear energy, industrial physical science, and atomic radiation.

At the Highland Park, New Jersey High School, an experimental program is being conducted with selected senior students. Two groups of 23 each, meet two hours a week, one with an organic chemist from the Squibb Company, and the other with a medical chemist from Johnson and Johnson Company. The groups reverse instructors every eight weeks. The industrial scientists are made available by their employers without charge. Plans are being made for expansion of the program.

In the spring of 1957, twenty seniors of the Moorestown, N. J. High School, were given an intensive twelve-week orientation course by volunteer local electronic engineers of the Radio Corporation of America. The students were seletced on the basis of achievement in science and interest in electronics. The content included lectures and demonstrations on principles of electronics, career information, laboratory techniques, and the use of test equipment. At the end of the series, the participants were given the five-tube radio receivers they had constructed as part of the laboratory exercises. Certificates were presented at closing exercises held in the R. C. A. Engineering Plant. The reception was so enthusiastic that another group of twenty students undertook the program in the spring of 1958. Nine Thursday evening lectures of 1½ hours each were scheduled at the R. C. A. Moorestown Engineering Plant, and four Saturday morning laboratory sessions of four hours each were held in the high school.

The Heart Association of Southeastern Pennsylvania provides grants up to $800 for acceptable high school science research projects involving a science teacher and no less than six above-average interested students. Work on the project is to be not less than four hours each week for thirty weeks of the school year, in the school laboratory and in visiting medical research laboratories. Of the grant, up to $600 may be allocated to compensating the teacher for hours worked after the school day, and up to $200 for materials required.

A modest program begun at Niles Township High School in Skokie, Illinois, in the fall of 1955, has stimulated many others in both large and small communities. Scientifically gifted students in grade 10 through 12 are rigorously screened on the basis of school record, IQ, and score on the Westinghouse Talent Search examination from the previous year. These students meet two hours on Wednesday evening the year round, for seminars, lectures, and research projects. Guidance is provided by local scientists volunteering their services for $1 a year. The enthusiasm of the son of an industrialist named Mr. Joe Berg resulted in the formation of the Berg Foundation, which has encouraged the spread of similar seminars in large cities as Pittsburgh, and in townships the size of Cheltenham, Pennsylvania, and smaller. Pitman, New Jersey,

has three advanced classes of seniors meeting in the school one-and-a half hours each week. Instruction is provided in physics, chemistry, analytic geometry, and calculus, by research scientists from the DuPont and Socony Mobile Oil Companies.

Scientists for Teachers

Conventions unquestionably have considerable value for participants. Ideas are secured from outstanding anthorities, friendships are established encouraging interchange of experience, and exhibits broaden resources. Heightened morale and other psychological gains are realized from the total convention experience. Often, however, the teacher who has most to gain from a convention cannot be spared from the classroom, owing to budget restrictions which limits the hiring of substitutes, and also the lack of available replacements. The Washington area met the problem in an ingenious fashion at the time of the NSTA Convention there in March, 1956.[1] Over 700 industrial scientists and engineers replaced in the classrooms 350 science teachers, enabling them to attend the convention sessions for one or two days. The results were generally successful, and led to further closer relationships between the local science groups and the school.

This relief of teachers for attendance at conventions by local science teachers has been utilized with equal success in other communities. Engineers and scientists took over the teaching day of Fairfield, Connecticut, science teachers, enabling them to attend in October, 1957, the NSTA Regional Conference in Hartford. Twenty scientists were one-day replacements for twenty junior and senior high school teachers from Stamford, Connecticut, who attended the same conference.

Members of the Engineers Club of Baltimore served as substitutes for mathematics teachers attending their convention recently in Philadelphia. Five local Baltimore industries contributed funds covering registration fees and transportation costs for 170 science teachers going to the 1956 NSTA Convention in Washington. In a similar fashion, industries in the New Britain, Connecticut, region paid for chartering a plane that enabled the science teachers to attend the NSTA Convention in Cleveland. The Indianapolis, Indiana Chamber of Commerce raised money in the spring of 1957 from local industries, enabling twenty-five teachers to attend regional and national conferences of science and mathematics teachers. The Indianapolis Board of Education budgeted funds in 1957-8 to send mathematics and science teachers from the eight local high schools to professional conferences.

The principal of the Highland Park, New Jersey High School reports that when one of his biology teachers was suddenly taken ill, a biologist (Ph.D.) was loaned by the Johnson and Johnson Company, at no charge for the two months, until a replacement was secured.

Job Experience

Participation by science teachers in actual laboratory work is another important help to better instruction. Summer experience of this sort has for several years been made available in many places, with sustained encouragement by the NSTA and ACS.[2] In the Philadelphia metropolitan area, the ACS has arranged for scientific and technical industries to employ some fifty science teachers each summer. Thus far, biology and general science teachers have not been able to share as extensively in these arrangements as have chemistry and physics teachers, in some areas.

Many industries employ collegiate science majors in summer and part-time jobs, hoping to gain these young people upon graduation as permanent employees. Summer work in science for high school students is less widespread than it should be, but is being utilized, nevertheless, in a number of communities. Each year the Philadelphia Science Council places some of its talent test winners in summer industrial laboratory work. High school and college science talent winners of the Science Clubs of America have been employed by commercial laboratories.

Seeing and Recognizing Talent

Nationwide scholarship and talent competitions are growing in scope and variety. Science fairs sponsored by cities, scientific organizations, industries, newspaper, service clubs, and other organizations have done much to encourage the scientifically talented students.

The Science Council of Philadelphia assembles several hundred outstanding seniors from the high schools of the metropolitan area on a Saturday morning in December for aptitude testing. All candidates are required to take a general aptitude test, and may select two achievement tests from the

(Continued on page 423)

[1] John K. Taylor. "The Washington Area Scientist for Teachers Program." *Journal of Chemical Education* 33:461. September 1956.

[2] Benjamin J. Novak. "And As For Industrial Experience." *The Science Teacher.* Volume 21, 5:211. October 1954.

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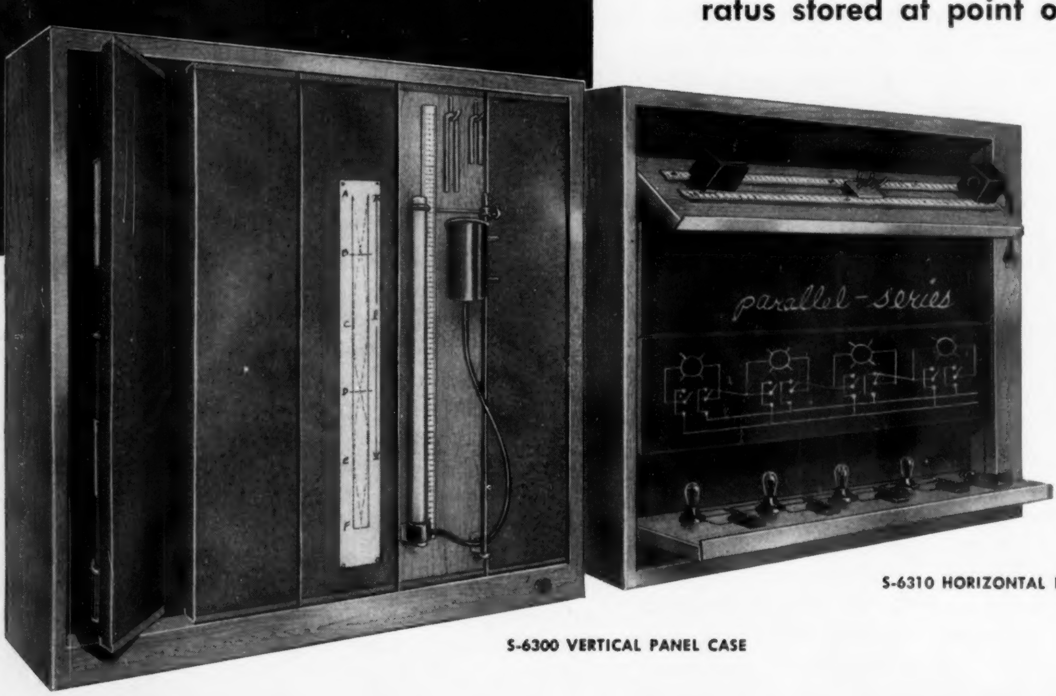


Demonstration panels illustrated are typical suggestions. You may mount your apparatus on these panels according to your own teaching techniques, for your own "finger tip" accessibility at point of use.

S-6310 HORIZONTAL PANEL CASE

S-6300 VERTICAL PANEL CASE

From Research to Classroom Laboratory...

HIGH TEMPERATURE, SHORT TIME PASTEURIZATION OF MILK

A Teacher-Pupil Activity for Chemistry Grades 10-12

By T. HANDLEY DIEHL
Central High School, Cincinnati, Ohio
ROBERT C. THOMAS and JEPTHA E. CAMPBELL
Department of Health, Education, and Welfare, Robert A. Taft Sanitary Engineering Center

Part I. Setting up the Pasteurizer

Teacher Background

Members of the Robert A. Taft Sanitary Engineering Center, indicated that high temperature, short time pasteurization of milk could be adapted to the limited equipment available in the average school science laboratory. The assembly was modeled after a laboratory scale tubular pasteurizer in use at the Sanitary Engineering Center; however, in lieu of a pump this apparatus was operated by gravity flow.

In heat treatment of foods, the higher the temperature to which the food is heated the shorter the holding time required to produce the desired thermal reduction of bacteria or enzymes. The primary object of pasteurization of milk is to destroy any pathogenic organisms that may be present. The time and temperature of pasteurization is based upon the present knowledge of the thermal death time of these organisms. The equipment is constructed to insure that every particle of milk is heated to the desired temperature and held there for the proper length of time to produce the desired lethal effect. The efficiency of the equipment can be determined by a study of the heating, holding, and cooling curves and plotting these temperatures against time. Most studies are based upon an analysis of the initial amount of bacterial or enzyme present and the per cent destruction at the end of the process. As the bacterial flora of the milk varies to a great extent and there is usually present an excess of heat resistant organisms that sometimes interfere with the bacterial analysis for pathogenic organisms, the laboratory test most commonly used at the present time is the phosphatase test. Fortunately the thermal inactivation curve for the phosphatase enzyme in milk is similar to the thermal destruction curve of most pathogens.

Problems

Certain substances interfering with the phosphatase test can be overcome by the use of proper controls. Another problem in flow-type pasteurization equipment is the determination of the so-called fastest particle flow time. The average flow time can be determined by flow meters or by noting the amount of liquid delivered at the outlet of the apparatus in a measured period and comparing this volume or weight with the volume or weight of fluid in the holding section of the equipment. Holding times calculated on this basis assume that the flow front of the liquid travels with a front perpendicular to the sides of the pipe. The flow front of a liquid, however, is more conical in shape, depending upon the drag effect of the liquid near the pipe wall. With more viscous substances the center of this stream projects farther ahead of the portion nearer to the wall of the tube. This effect is overcome to some extent by methods that contribute to greater turbulence of the stream. In the present assembly the holding time in a small bore tube was calculated upon the basis of the delivery time and not on the basis of the co-called fastest particle time. In commercial equipment the so-called fastest particle time is usually calculated upon the travel time of a salt solution between two electrodes in the holding section.

Student Background

The Robert A. Taft Sanitary Engineering Center is interested in the modern methods of pasteurizing milk. Their primary concern is that milk be properly pasteurized. At times, however, even though

seemingly all precautions are taken in this endeavor, an occasional sample will indicate to the contrary.

There are four methods of pasteurization in use in this country today. These methods depend upon the sudden elevation of temperature, a short holding time at that temperature, and sudden cooling. It is understood that the higher the temperature to which raw milk is heated, the less time will be needed to hold the milk at that temperature to do the same job of killing bacteria.

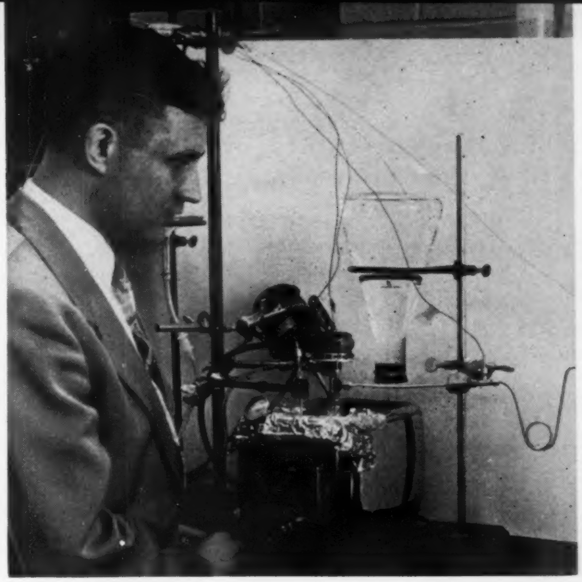
Generally the method of testing the effectiveness of pasteurization does not depend upon the killing of bacteria and the testing for bacteria remaining, but rather on the existence of the phosphatase enzyme. This method has been chosen since the killing of the phosphatase enzyme coincides measurably well with the killing of harmful bacteria in raw milk. The test that is used in the testing of milk for human use involves a phosphatase test. The flash pasteurization method, as some of these more modern methods of pasteurization are termed, at times shows the milk to be improperly pasteurized. The Taft Sanitary Engineering Center has been making exhaustive tests.

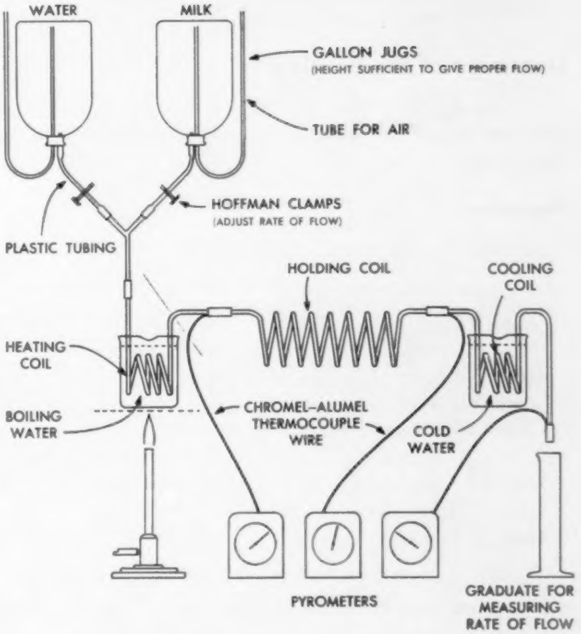
The Taft Sanitary Engineering Center has set up a small working laboratory short-time pasteurizer. It is an extremely simple arrangement and is one that can be duplicated in the high school classroom with a fair amount of ease. Essentially all that is needed is some aluminum or stainless steel tubing and some plastic tubing through which to run the milk. Copper tubing is avoided since contamination with small amounts of copper can result.

To check the temperature involved thermocouples are used, since the diameter of the tubing is too small for thermometers. These very effectively indicate the temperature of the moving fluid. Rate of flow measurements are necessary to check the holding time on the milk.

In commercial equipment the so-called fastest particle flow time in the holding tube is measured as the holding time. In certain cases this time is faster than the average flow time as calculated from the capacity of the holding tube and the weight or volume delivery time at the outlet of the pasteurizer. In these experiments with a tube of small diameter all holding or flow times are calculated upon the basis of the average flow time.

To check the effectiveness of this method of pasteurization the phosphatase test is employed to determine the effectiveness of controlling biological action. Basically the test depends upon the enzyme reaction with certain reagents, which in the reaction liberate phenol. The phenol is then reacted

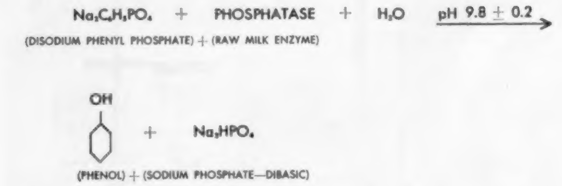




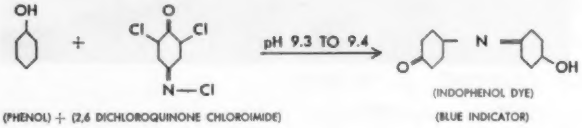
Short Time Pasteurizer Laboratory Model

with other reagents to give a characteristic color test. The disadvantage arises from the use of materials which may inadvertently contaminate the milk with phenol such as some plastics. In this case the sensitive test is not recording a true positive indication about pasteurization methods, but rather about the contaminants that entered during some part of the process. Modifications of the test are concerned with the removal of substances such as vanillin which essentially have phenolic ring structures that might split out phenol in the process. False positive tests are determined and corrected for by running proper controls with each test. In this experiment the efficiency of the pasteurization process is checked by the phosphatase test method.

The chemical reactions involved in the phosphatase proceed as follows.



The phenol thus produced above then reacts with an indicator to give indophenol which has a characteristic blue color.



Statement of the Problem

To make a study of an industrial method of pasteurization of milk through laboratory experimentation.

Procedure

Setting up the pasteurizer

Materials

⅛ inch stainless steel or aluminum tubing .... 25 ft
(capacity =0.0743 ml/in approximately)
400 ml beaker (2)
1 gal jug (2)
Chromel-alumel thermocouple wire
(no. 24 gauge) .... 25 ft approx
polyethylene tubing .... approximately 4 ft
Glass Y-tube (1)
Hoffman screw clamps (2)

1. Set up both gallon jugs high enough so that the rate of flow through the tubing will be close to one ml per sec.

2. Coil the aluminum tubing so that at least 15 inches of the tubing can be immersed in boiling water. (This is the heating coil for the milk.)

3. Make another coil so that approximately 210 inches of the tubing is used to hold the milk at 161°F for 15 seconds or longer. (This is known as the holding section.)

4. Make a third coil of the tubing so that at least 15 inches can be immersed in an ice water bath for cooling. (In place of the cooling coil the milk can be allowed to drip from the holding coil directly into a test tube immersed in ice water.)

(The aluminum coils can be wound on a beaker and slid free for use in the experiment.)

5. At each joint of the aluminum tubing short sections of polyethylene tubing can be used.

6. At the joint between each coil slide the thermocouple wire between the plastic tubing and the aluminum tubing so that the junction of the thermocouple is in the center of flow of milk.

7. Wrap and tighten wire around the joints to prevent leaks.

Calibrating the thermocouple

1. Bare the wires of the thermocouple wire and twist the two wires together. (Mercury weld or silver solder for a more permanent bond.—See note on mercury welding—.)

2. Insert the twisted ends in an ice bath.

3. Attach the other ends of the wires to a sensitive pyrometer or potentiometric circuit.

4. Record the deflection of the galvanometer (pyrometer) with the leads in the ice bath. (This will be 0° C or 32° F.)

5. After the deflection has been recorded for ice water, insert the twisted or welded junction in boiling water. (This will be 100° C or 212° F.)

6. Record the deflection of the galvanometer (or pyrometer) for the boiling water.

7. Calculate the number of degrees per scale division by dividing the scale divisions the needle was deflected between the boiling and freezing point of water into 100 for centigrade degrees or 180 for Fahrenheit degree. (Remember to add 32 to the reading of the Fahrenheit scale to read correctly on the Fahrenheit thermometer.)

Mercury Welding

1. Use an evaporating dish half full of mercury.

2. Connect one side of the 110 volt house current to the mercury in the dish.

3. Connect the other side of the 110 volt line to both leads of the thermocouple wire.

4. Twist the leads of the bare thermocouple wire together.

5. Insert the twisted leads briefly in the mercury. (The heat from the dead short will melt the alumel so that it will fuse to the chromel. If done properly, a small bead appears at the junction of the two wires.)

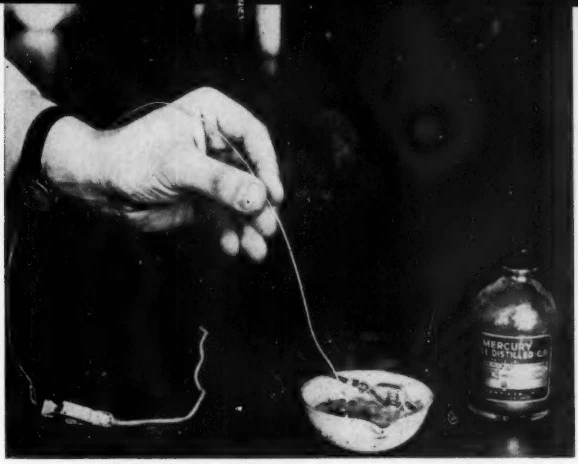
6. Untwist the leads of the thermocouple wire so that each lead contacts the other only at the bead.

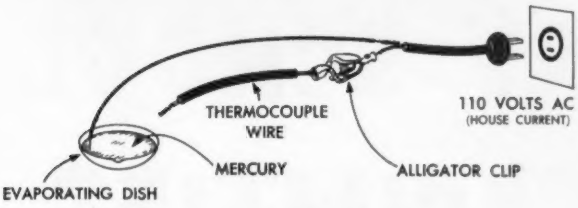
Part II. Running the Pasteurizer

1. After the pasteurizer is completed and the thermocouple calibration sufficiently accurate, begin the operation with water and record the rate of flow.

2. Begin heating the water in the beaker around the heating coils.

3. When the water flowing through the system gives a temperature reading that is high enough for effective pasteurization (161° F), switch the





Mercury Welding

system to raw milk. (Caution!! If milk is run into the hot coil without the water preceding it, the milk will "cook-on" the inside of the tube and stop the flow or give incorrect results.)

4. Discard the first few milliliters of milk that come through after switching from water to milk.

5. Collect the milk sample at the rate of one milliliter per second and subject the sample to the phosphatase test.

6. Absence of blue color in the phosphatase test indicates the milk is properly pasteurized.

Phosphatase Test

Equipment[1]

Measuring pipette—10 ml graduated to 0.1 ml
Test tubes 12 x 114 mm
Stoppers for test tubes (phenol free)
Funnel

Solutions[1]

1. Buffer—Dissolve 100 grams sodium sesquicarbonate dihydrate ($NaHCO_3 \cdot Na_2CO_3 \cdot 2H_2O$) in water to make one liter of solution.

2. Buffer substrate—Dissolve 0.5 gram of phenol free disodium phenyl phosphate crystals in distilled water, add 25 ml of the buffer above and make up to 500 ml of solution.

3. CQC reagent—Dissolve 30 mg of crystalline 2,6 dichloroquinone chloroimide in 10 ml of methyl or ethyl alcohol. (Store in stoppered bottle under refrigeration.) For use transfer a few ml (5-10 ml) to a brown dropping bottle with phenol free closure and dropper calibrated to deliver approximately 50 drops/ml. Discard solution if solution turns brown.

4. Catalyst—Dissolve 200 mg of copper sulfate ($CuSO_4 \cdot 5H_2O$) in 100 ml of water.

5. n-Butyl alcohol—Add 0.1 N NaOH to alcohol until small portion tested with bromthyol blue indicator gives green or light blue color.

[1] For further details or for information concerning equipment and supplies write the authors at Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Procedure

1. Use clean pipettes for each sample.
2. Add 0.5 ml of well mixed milk sample to 5 ml of buffered substrate by means of a pipette.
3. Warm the mixture to about 40° C and then incubate at this temperature for 15 minutes.
4. Add 2 drops of catalyst and 6 drops of CQC solution.
5. Mix well, and reincubate for 5 minutes.
6. Remove the tubes and add 3 ml of n-Butyl alcohol (neutralized).
7. Extract the indophenol blue by quickly inverting the tubes 4 times.
8. Any blue color is indicative of improper pasteurization.

Controls

1. Negative milk control—Prepare by boiling milk for 5 minutes and cooling. After running through the procedure above, no blue color should be observed.
2. Positive milk control—Prepare by adding 0.5 ml of raw milk to ½ pint of boiled milk or one drop of 0.1 per cent phenol solution per ml of boiled milk.

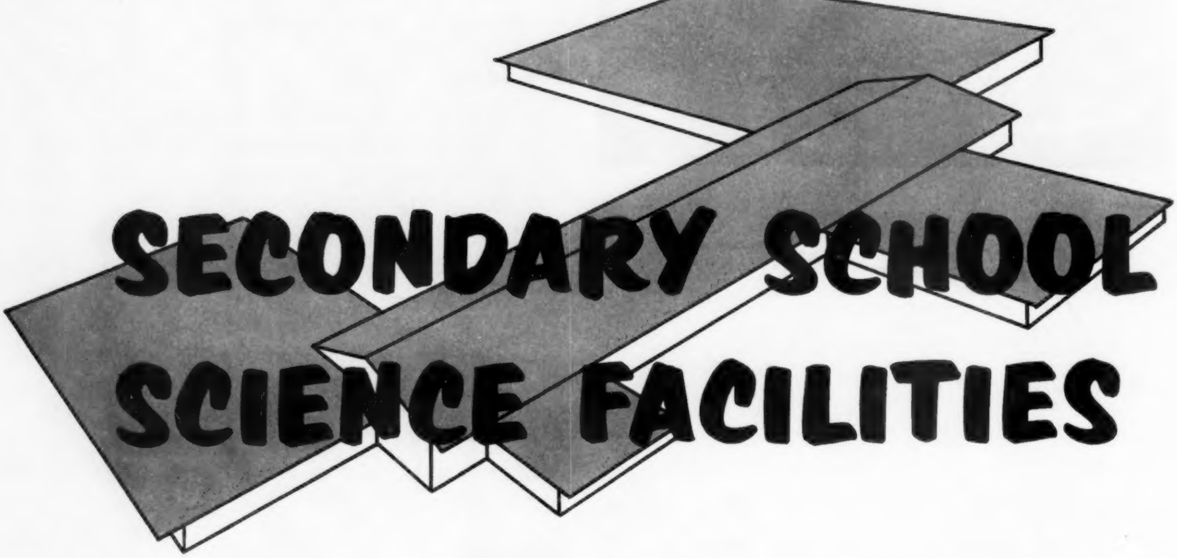
Optional Solutions

1. Phos-phax tablet (Buffered substrate)—Dissolve one tablet in 50 ml of distilled water.
2. Indo-phax tablet (CQC reagent)—Dissolve one tablet in 5 ml of methyl or ethyl alcohol.

Optional Procedure

1. Use clean pipettes for each sample.
2. Add 0.5 ml of well mixed sample to 5 ml of phos-phax tablet solution.
3. Warm the mixture to about 40° C and incubate at this temperature for 15 minutes.
4. Add 6 drops of the indo-phax solution from an eye dropper that will deliver about 50 drops per ml.
5. Mix well, and incubate for 5 minutes.
6. Remove tubes and add 3 ml of n-Butyl alcohol (neutralized).
7. Any blue color is indicative of improper pasteurization.

(Continued on page 405)



SECONDARY SCHOOL SCIENCE FACILITIES

Recent Construction—How Effective?

By THEODORE W. MUNCH

Chairman, Science Facilities Committee, University of Texas, Austin

A. WHAT THE STUDY WAS ABOUT

With the increase in school populations, communities throughout the United States are erecting many new school buildings or are renovating old structures. What do science teachers think about the science facilities which are a part of the new construction? Are the facilities meeting the standards necessary for good teaching? What new trends and innovations are appearing? What mistakes should be avoided in future construction? Partial answers to these questions have been obtained from the study of a questionnaire prepared by the Science Facilities Committee and distributed nationally to science teachers through the NSTA Science Packet.

The Committee received 251 responses to the questionnaire; 234 of which were finally used in assembling data for this report. The number of states represented was 41, and it is interesting to note that replies were received from 5 foreign countries and territories: Italy, the Bahamas, Canada, Puerto Rico, and Hawaii. These replies were not included in the study. 192 forms were received from high schools and 42 from junior high schools. The respondents were asked to evaluate those science installations constructed between 1953-58.

182 replies indicated that completely new science areas were installed, 36 stated that their facilities have been renovated, and 16 schools recorded that both new and renovated facilities have been installed since 1953. Those states with 10 or more new or renovated science facilities are as follows: California (28), New York (20), Pennsylvania (14), Illinois (13), Wisconsin (12), Michigan (11), and Texas (10).

Table I. Who Designed the Science Facilities?

Personnel Involved	*Number of Schools*
1. Science teacher, principal, superintendent, and architect	123
2. Architect only	53
3. Science teacher only	29
4. Superintendent and principal	3
5. Other	26
Total	234

Table I indicates the variety of persons responsible for planning the science rooms.

Item "5", Table I, included a variety of combinations, some of which were: (1) a group of scientists from a state university and the science teacher, (2) the superintendent, principal, architect, teacher, and representatives of the state department of education, (3) a chemical engineer from a local paper company, and (4) the architect in conjunction with various combinations such as a committee of the school board and science teachers, the science supervisor and science teacher, and head of the science department and commissioner of public works.

Table II. For What Areas Were the Science Facilities Designed?

Area	*Number of areas*
1. Some combination of the sciences	124
2. General Science Only	74
3. Chemistry Only	56
4. Biology Only	51
5. Physics Only	46

204 schools reported on the adequacy of the size of their facilities. 137 of the 204 schools stated that the new rooms were accommodating a number of students less than or equal to the number for which the rooms were designed. 47 schools reported that the average class sizes were greater than the number of students originally planned for. 20 schools observed that the class accommodations were too small for some classes and sufficient for others.

Table III. What Space Is Devoted to Classroom-Laboratory Facilities?

Area in sq. ft.	*No. of areas*	*Area in sq. ft.*	*No. of areas*
300–400	8	1,500–1,600	3
400–500	6	1,600–1,700	3
500–600	2	1,700–1,800	1
600–700	10	1,800–1,900	2
700–800	6	1,900–2,000	3
800–900	23	2,000–2,100	1
900–1,000	12	2,100–2,200	1
1,000–1,100	10	3,000–3,100	1
1,100–1,200	5	3,500–3,600	1
1,200–1,300	13	3,700–3,800	1
1,300–1,400	3	3,900–4,000	1
1,400–1,500	1	4,000–4,100	6

Table II shows the specific science areas constructed.

Table III indicates the space in square feet devoted to 123 teaching areas designed as combined classroom-laboratories. Table IV indicates the space allocated to storage in 190 schools.

Table IV. What Space Is Devoted to Storage Facilities?

Area in sq. ft.	*No. of Schools*	*Area in sq. ft.*	*No. of Schools*
Less than 50	9	600–650	2
50–100	27	650–700	1
100–150	41	700–750	2
150–200	29	750–800	2
200–250	25	900–950	4
250–300	11	950–1,000	1
300–350	6	1,000–1,050	1
350–400	3	1,250–1,300	1
400–450	7	1,300–1,350	1
450–500	7	1,600–1,700	2
500–550	5	1,700–1,800	2
550–600	1		

Science teachers were asked to rate facilities within their rooms in the following manner: 1 = superior, 2 = good, 3 = fair, 4 = poor, M = missing. If the teacher rated a facility as "4", he was asked to state briefly what was wrong. Finally, the teacher was asked to describe any facilities in his science area which he believed to be unique and particularly effective in science teaching. The data gathered from these questions are tabulated in Tables V and VI. The number of responses for each item was converted to a per cent of the total usable responses and is so shown in the tables.

B. WHAT THE STUDY REVEALED

Richardson (1:18) points out that the central group responsible for the planning of science rooms should be composed of the administrator, the science teacher, the specialist in the teaching of science, the school building consultant, and the architect. While no school reporting in this study met all of these qualifications, 123 schools appeared to have an adequate planning committee in the science teacher, principal, superintendent, and the architect. Some of the teachers' comments on planning indicated that they (the teachers) were consulted but that their recommendations were considered lightly or that the architect's voice was the strongest with the

administrator and the teacher following in that order. Many replies indicated that inadequate facilities resulted from planning by persons not familiar with science activities in the classroom. It would appear that more schools need to achieve a more concerted planning effort in which the experience of teachers and science teaching specialists, as well as architects and administrators, are included in the evaluation.

Table II indicates a continuation in the trend toward the construction of the multipurpose science room. These rooms generally were combinations for (1) chemistry and physics, (2) chemistry, physics, and general or physical science, or general science and biology. All teachers having combined lecture-laboratory areas were well pleased with the arrangement and stated that it enabled the teacher to carry on a variety of activities at one time under supervision.

Richardson (1:21) states that effective science teaching requires a per-student area of 35-40 sq. ft., exclusive of storage rooms, preparation rooms, and dark rooms. If it assumed that each area in Table III is occupied by 25 students, and if the minimum figure of 35 sq. ft. is used for computation, then 875 sq. ft. is the minimum required for 25 students. 32 schools, or approximately 26%, had less than the minimum considered essential. Some of the schools with exceptionally large areas were former home economics rooms or gymnasium facilities renovated for science teaching. Frequent mention was made of aisle spaces between desks as being too narrow. Some spaces were only 24″.

Richardson (1:21) considers an additional 10-15 sq. ft. per student as the minimum essential for storage rooms, preparation rooms, and dark rooms. Assuming that 10 sq. ft. per student is the figure used, and that the class size is 25, then there should be a minimum of 250 sq. ft. of storage per science room. 106 schools, or approximately 55%, reported that they had only 200 sq. ft. or less of storage area. Complaints about the storage areas centered about the following (1) potential storage space was not used, (2) insufficient space was allotted, and (3) storage areas were inconveniently located, some being at the end of the room opposite the demonstration table.

Table V reveals that teachers rated most new facilities as either superior or good. Certain items were rated only fair, and some facilities which many teachers considered essential or very desirable were missing in many schools. These include: room darkening facilities, display areas, classroom library facilities, and office and consultation areas. Specific complaints, frequently repeated, are itemized below. Demonstration table lighting is frequently inadequate and should be remedied by accessory spot lighting. In one case, utility outlets were located under the table instead of on top. Drains were too small and clogged easily. Kitchen-type sinks are still being installed in some chemistry laboratories. There were often insufficient water and gas outlets, and they were frequently placed in inconvenient positions about the room. Chalkboards were often placed too low, and some of the board was obscured by the demonstration table. Green chalkboards were frequently rated as unsatisfactory because the chalk could not be easily erased. One 8′ x 4′ board was not considered sufficient. Venetian blinds were not rated as satisfactory darkening facilities. Glass brick was considered to be more of a hindrance than a help, and some schools reported that they had to paint over this surface to

(Continued on page 416)

Table V. How Did Teachers Rate Lecture-Demonstration Facilities?

Item	*Rating: % responding, to nearest 1%* 1	2	3	4	M	*Usable Responses*
a. Demonstration table size	48	40	9	2	1	228
b. Demonstration table lighting	28	45	16	5	6	229
c. Visibility of demonstration table	38	43	16	3	0	231
d. Demonstration material storage	26	33	29	9	3	231
e. Exterior lighting control	26	40	12	7	15	207
f. Interior lighting control	48	36	12	0	4	224
g. Gas utilities	62	28	5	2	3	230
h. Water utilities	59	30	7	3	1	229
i. Electrical utilities	58	27	10	4	1	229
j. Chalkboard location	56	32	9	3	0	231
k. Chalkboard size	40	35	17	8	0	232
l. Chalkboard surface	50	30	13	6	0	230
m. Projection convenience	26	30	19	15	9	232
n. Room darkening facilities	21	28	16	13	22	227
o. Display areas	22	31	24	9	13	230
p. Tackboard location	35	35	19	6	5	229
q. Acoustical treatment	46	39	9	3	2	228
r. Floors	51	38	8	3	0	230
s. Library Facilities	25	34	19	9	13	228
t. Student Furniture	43	37	13	7	0	230
u. Office and consultation area	19	15	11	7	47	230
v. Drains and waste disposal facilities	50	32	11	6	1	229

What Qualities Must the Science Teacher Possess?

By CHARLES KOEPKE III

Marshall Junior High School, Stockton, California

Based on presentation during Panel Discussion, "What Constitutes Effective Science Teaching," at the Sixth National Convention of NSTA, March 28, 1958, Denver, Colorado.

THE TEACHER MUST HAVE:

1. *The ability to instill curiosity by being curious himself* . . . to take students on a field trip and be one of the first to turn over a rock or break open a rotten log; one of the first to probe with muddy fingers for specimens; or tiptoe silently in order to spot a squirrel eating; to want to find out as much as the kids do, how anemones eat; or why birds fly or spiders spin webs; or why sound is slower than light in velocity; or animals are different in many ways; or why some metals can be hammered while others cannot.

2. *The ability to be as enthusiastic over a graduate course in nuclear physics as well as* . . . discovering with students the reasons behind why the school sidewalk was covered with earthworms after a rain; or telling the life story of Einstein and relativity; Edison and the electric light; or Salk and vaccine.

3. *The ability to recognize successful achievement in everyone regardless of whether* . . . it was Sputnik being launched by a Russian scientist; it was a science fair first place award won by a gifted 150 I. Q. ninth-grade student on electric computers.

4. *The ability to realize and convey to the students and parents, fellow teachers and administrators, the public and nation as a whole, the fact that* . . . the mystery and beauty of the universe strengthens, rather than weakens the religion we cherish, when studied in the light of science; nationalistic boundaries and cultural heritages and racial characteristics and physical deformities and environmental backgrounds and inherited genes serve as outstanding illustrations of the universal fusion of great men of science, rather than lines of demarkation separating them. Teaching and realizing this that—Von Braun is the son of an aristocrat and was once a German citizen . . . while Carver was a Negro and the son of a slave family in Georgia, U. S. A., and Einstein was a Jew, and Steinmetz was a hunch-back, and Edison was essentially deaf, and Fermi an Italian, and Ziolchovsky a Russian.

5. *The belief in and the practice of the philosophy that* . . . the world of science is more than milk carton barometers and ribbon thermometers, or nails with copper wire around them, or water boiling on a hot plate, or reading from pages 6-16 in the textbook and answering the questions at the end of the chapter. That the science teaching profession is more than taking roll, talking about seashells, grading tests, having a free period, seeking a raise.

Also he must be . . . as doubting as Thomas, as humble as Paul, as dedicated as the Curies, as well-rounded as Da Vinci, as exhilarated as Hillary on Everest, as awed as Beebe in the ocean depths, as versed in psychology as Freud, as serene as Buddha, as zealous as Mohammed, and as loving as Christ. Also a combination of Gandhi and Luther, Schweitzer and Goddard with the vision of the Wright Brothers, the desire for improvement of Dewey, the energy of Teller, and the patience of Job. All this and still be as human as Truman.

6. *Finally, a junior high school science teacher must believe that teaching is a way of life* . . . it is taking a group of Boy Scouts on a nature hike, it is allowing your five-months old daughter an early chance to explore the mechanical fascination of the space bar on your typewriter, or letting your son tear up a tulip that just bloomed in order to find out what the bee was looking for inside.

And most important . . . it is the complete dedication to a belief that science and all areas of education and our way of life, and the farmer's cause in 1776, and the sending of a rocket to the Moon, and a chapel in the forest are all things worth believing in, fighting for, educating for, giving up sleep for, being underpaid for, and if necessary sacrificing energy, health or life for, and without these—

> "Yours is a tale told by an idiot
> Full of sound and fury, yet signifying nothing
> Tinkling cymbals and sounding brass,
> A job from morning till 3:15
> Nine months a year, nothing more . . ."

Classroom Ideas

General Science

Microprojection Method

By RUTH FRANK, The Pennsbury Schools,
Bucks County, Pennsylvania

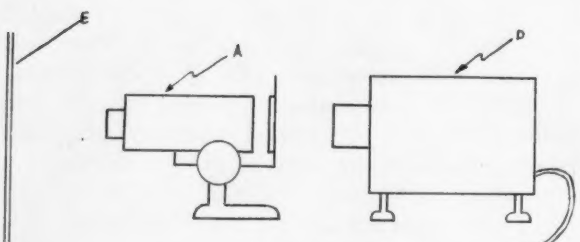
Two readily available pieces of equipment in a classroom can be combined to provide a microprojector without any additional cost, and within a short period of minutes.

Materials

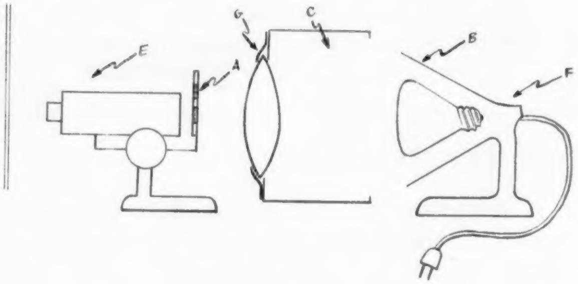
A. Microscope in tilted position with mirrors, or with lightbox removed
B. Coffee can
C. Convex condenser lens (if available)
D. Slide projector
E. White cardboard, screen, or canvas surface
F. Spotlight
G. Tape

Discussion

I. A simplified system is devised by use of the tilted microscope and an unmodified slideprojector. The slideprojector (D) used for its strong light source and lenses, should be very close to the microscope (A). Thus the board, or screen (E) may be moved, providing greater magnification with a corresponding loss of brightness. The relative position of these objects may be modified according to the size of the class.



II. A construction experiment by the class.



Elementary Science

Teaching Aids in Astronomy

By ALBERT J. READ, State University Teachers
College, Oneonta, New York

Teachers introducing students to astronomy usually encounter the problem of having the students properly visualize the earth as it rotates and revolves. This visualization is necessary for the understanding of day-and-night, the production of the seasons, the moon's phases, and the positions in the sky of the sun, moon, and stars at various times.

Providing a simple and inexpensive model of the Earth and the Moon can be solved for an expenditure of about 25¢ for the materials. The Earth is a "Globe Bank," about 4 inches in diameter, obtainable for about 20¢, and the Moon is a solid rubber ball about 1 inch in diameter, costing about 5¢. Other materials required include a coat-hanger of fairly stiff wire, two blocks of wood about ¾″ thick (one about 6″ square, the other about 1 inch by 2 or 3 inches) and a brass nut or washer having a hole which is slightly larger than the diameter of the coat hanger wire.

The completed assembly is shown in Figure 1. The brass nut or washer is soldered to the wire (and *not* to the Earth) at the Earth's South Pole about 1 or 2 inches above the bends. This is done

to emphasize the Earth's axis of rotation. For safety, the end of the "North Pole" is bent over to form a loop. It is desirable to give the "Moon" a coat of aluminum paint.

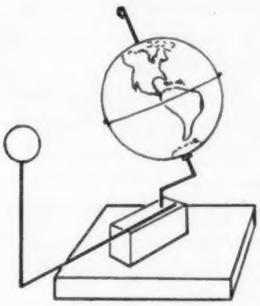


Figure 1

The small block to which the Moon's wire support is attached has a hole slightly larger than the wire, so that the Moon may revolve freely around the Earth. The Earth's support wire is fastened to the base by drilling a hole which is just a bit smaller than the wire, and then pushing the wire into it. More detailed instructions can be obtained through correspondence with the writer.

The sun can be simulated, of course, either by a bare light bulb or by a projector.

Activities involving the use of this model should be preceded by developing an awareness of the distortions in scale. For example, in this model where the Earth is 4 inches in diameter, the Moon should be placed 10 feet away. This is obviously more coat-hanger wire than most of us can conveniently manipulate in a classroom. To the same scale the Sun would be the size of a small house, and about ¾ mile distant.

Students may be aided in visualizing their location and orientation on the model by the use of a tiny figure made of modeling clay standing on the globe's surface.

A second device, involving no cash outlay, successfully simulates some of the features of solar eclipses. These spectacular events are rarely witnessed by students, and some have difficulty visualizing partial eclipses, total eclipses, and annular eclipses. The device consists of a piece of cardboard or other opaque material in which one cuts a circular hole having a diameter about 10% greater than the diameter of the moon in the above-described model. A frosted light bulb is placed close behind the hole, and the model's Moon placed a few feet in front of the hole. On a sheet of paper behind the Moon one can obtain the shadow of the moon, showing its umbra and penumbra. The conical shape of the umbra can either be deduced by observation as the paper is moved farther away from the Moon or by setting the apparatus so that the Moon's shadow grazes a long, vertical surface (such as a wall or a cabinet door). Many students are dismayed to find that there is no definitely visible boundary between the umbra and the penumbra.

Total and partial solar eclipses can be simulated by the student's closing one eye and maneuvering the other eye into the umbra and penumbra respectively (Figure 2). An annular eclipse is simulated by backing away several yards while keeping the "moon" centered on the "sun." The typical ring of light around the moon is readily observed.

It has been found that it is very helpful to use a small mirror. This mirror enables the student to see his own eye when located in the various parts of the shadow.

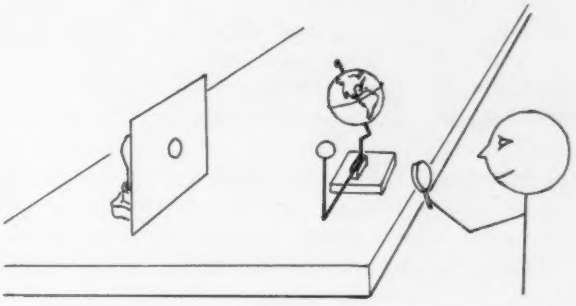


Figure 2

The student might also keep his eye in the appropriate position while moving the moon, thus giving the appearance of a total eclipse from beginning to end.

The writer makes no claim of being the original inventor of the above devices, but they seem novel enough to warrant widespread sharing with other science teachers. Due to the simplicity and economy of the above aids, teachers will find it possible to make several replications if they are intended for classroom use. It is the writer's observation that four or five students sharing one apparatus is about the maximum for effective small-group learning experiences in class.

Physics

A Fool-proof Electroscope

By EDWARD J. SKIBNESS, Minneapolis

Figure 1 shows an electroscope that is fool-proof, economical and simple to make. In fact it is so simple, a student will enjoy making it and having one of his own. This electroscope is in every way as sensitive as one with gold-leaf or the delicate aluminum-foil and will withstand most any rough treatment.

Most any common clear wide-mouth bottle can be used for a container. The one described here is a Bufferin bottle. The stopper for the bottle can be a cut off cork, rubber stopper, or one made up of four layers of cardboard disks.

Figure 2 shows how to make the cardboard stopper. First cut from cardboard a strip that will just fit into the neck of the bottle. For a Bufferin bottle this strip will be $\frac{3}{4}''$ wide. Then on the cardboard strip lay out three squares with their diagonals and with a compass draw the circles to outline the disks as shown in figure 2A. Also lay out a square for a top disk which has a radius $\frac{1}{8}''$ greater than the three other disks.

You next cut out the disks and glue or paste them together as shown in figure 2B. If airplane glue is used, the electroscope will work as soon as the other parts are made. With a hack saw blade saw in on one side to a little past the middle of the stopper and as shown in figure 2C.

The metal rod and its ring at the top is made by forming a $\frac{1}{8}''$ x $3''$ and a $\frac{1}{8}''$ x $4''$ tin metal strips as shown in figure 3. First make the strips even at their middle. Then at their middle form a loop around a $\frac{1}{8}''$ cylinder. With your pliers pinch the legs of the loop together near the cylinder. Next place a $\frac{1}{8}''$ tin metal band once and a half around the legs close to the loop. Also place a $\frac{1}{8}''$ tin metal band once and a half around the legs near the ends of the shorter strip. The two single ends of the legs are then bent outward and upward over an 8d nail to form hooks as shown in figure 3A. The rod is now ready to receive the aluminum leaves.

The aluminum used for the leaves is ordinary kitchen aluminum foil or such as one may find on chewing gum or candy. First cut two pieces of foil $\frac{1}{2}''$ x $1\frac{1}{2}''$. At one end of each piece, $\frac{1}{8}''$ in, use the point of a knife blade to make a slot $\frac{1}{8}''$ long across the middle. Figure 3B shows how you attach the leaves to the rod by slipping the ends of the upturned hooks thru the slots in the leaves. Then push the upturned ends of the hooks in toward the rod to prevent the leaves falling off.

The next step is to slide the rod into the cut in the stopper and then placing the rod assembly into the bottle. A metal ball for the top can be made by first rolling up a ball of paper as large as the ring and then placing over the paper ball two or three layers of aluminum foil. The ball or sphere will add very little more than appearance.

This electroscope is quite responsive to plastics, rubber, or pieces of ordinary glass. It can also be used for any of the conventional experiments done in laboratory work. Besides that it gives the student a science project for home work.

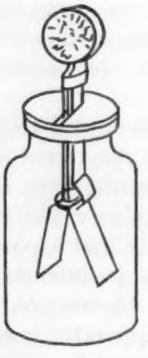


Figure 1

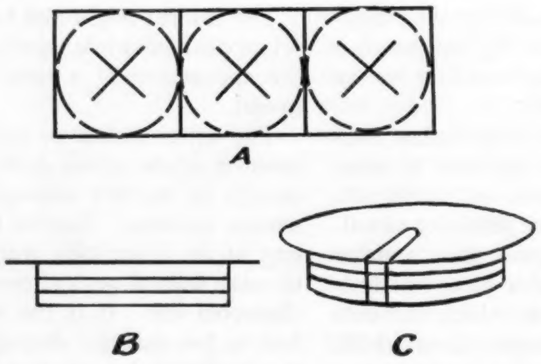


Figure 2

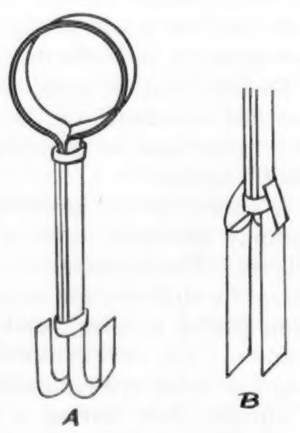


Figure 3

DIEHL . . . from page 397

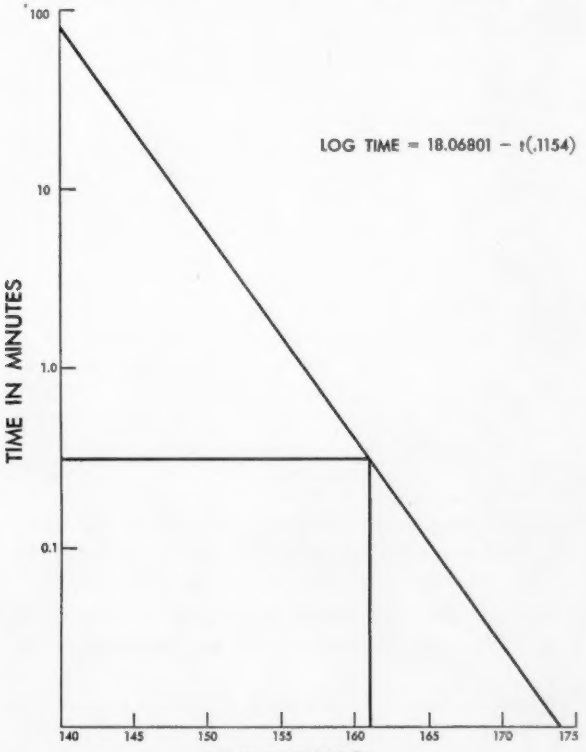
Summary

Since Louis Pasteur first introduced pasteurization as a means of controlling bacteria in liquids, his methods have been modified to a considerable extent. Pasteur's "batch" method required the liquid be heated to 143° F for 30 minutes. The short term methods such as we are using require 161° F for 15 seconds. Another method, which works on the vapor pressure of water and the injection of live steam into a spray of milk, uses a temperature of 194° F for ¾ of a second. Yet another method involves a temperature of 205° F for ¼ of a second. There is at least one company who marketed a pasteurization process involving the use of electricity and the electrical resistance of the milk for heating. This electrical method uses the 161° F temperature with a holding of 15 seconds.

In all the methods that are described it becomes clear that the higher the temperature to which the milk is subjected the less time is required to complete the process. Actually the relationship between the time involved and the temperature involved can be expressed as a straight line graph on semi-log paper. (Figure 1.) With this laboratory pasteurizer it is possible to change the rate of flow of the milk and also adjust the temperature to which the milk is subjected. It is easy to check out the straight line graph to see that pasteurization is completed as predicted.

It is obvious that the several phases of science cannot work independently of each other. Pasteurization is primarily concerned with the killing of harmful bacteria, but this can only be done with heat or chemicals. Physics plays the important role in heat exchange and the electrical measurement of temperature. Chemistry plays its role in the identification of certain chemical compounds that may or may not be liberated in the process.

Fig. 1. Phosphatase Reduction Regression Line



Suggestions for Further Study

There are several methods in use for checking the effectiveness of pasteurization. These could be correlated.

Larger diameter tubing could be used. In this case new flow rates would need to be calculated, since the flow rates were calculated for ⅛ inch diameter tubing in this experiment.

Variation on holding and heating temperatures might be calculated to see what effects they have on pasteurization.

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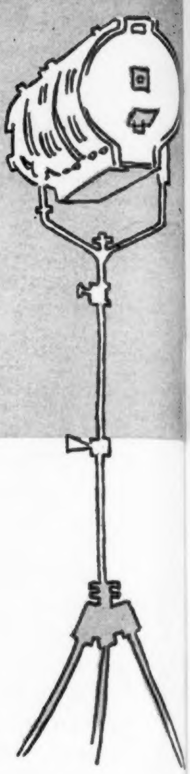
SPOTLIGHT on RESEARCH



Teaching Science by Means of Television

By BARBARA YANOWSKI

Producer-Telecaster, New York State Regents Television Project, *Science*

THE MEDIUM OF TELEVISION is making significant educational contributions in the homes of most students and teachers and in many classrooms in all parts of our nation. Television today is serving at least one thousand schools by open circuit on commercial and educational stations. Through closed circuit cable it reaches one hundred and thirty-three schools and more than one hundred colleges and universities. A great deal of research has been done regarding the effectiveness of this medium as an educational aid. The purpose of this article is to interpret a few studies which show how the medium of television can serve the science teacher.

At the present time, one of the most widely publicized television experiments is being conducted by the schools of Hagerstown, Washington County, Maryland where a closed circuit system services over 15,000 pupils from the kindergarten through senior high school. In their first report, published after a year and a half of intensive programming [1] and evaluation, one of their main conclusions centered around the impact of television in terms of its immediacy and directness. "Every seat in the classroom becomes a front row seat," they reported. "The teacher looks at the camera . . . and is looking straight into the eyes of each pupil who is watching. This seems to have a psychological effect that causes the pupil to give close attention to what is happening."

[1] *Closed-Circuit Television Project Notes.* Board of Education of Washington County, Hagerstown, Maryland. January 16, 1957.

Since television seems to have the unique ability to speak to each student and to command his attention in the manner just described, it is our responsibility to provide the kind of viewing conditions which will insure this type of rapport. Therefore, it might be well to keep the following checklist handy for reference.

1. Is the seating arranged so that everyone has a good view of the set? The ideal condition is approximately 25 students to each 21-inch screen.
2. Have the blinds been drawn and has care been taken so that no one is looking into the light as he looks at the screen?
3. Has the set been turned on and adjusted for sound and picture before program time?
4. Have you "set the scene" as well as possible by introducing the subject to be explored in terms of what's been happening in the classroom?
5. Have you been careful to avoid spending too much time preparing the class for the program in order to prevent it from becoming restless and bored before the program begins? In general, 5 minutes is ample time to discuss vocabulary, recall experiments, or raise questions.
6. Have you made arrangements to sit in the front of the room where you can observe the reaction of the class as well as what's happening on TV?

During the 1957-1958 school year, the New York City Board of Education [2] televised The

[2] William B. Reiner. *An Evaluation of the Effectiveness of a Television Series for Elementary School Children from Kindergarten to Grade 4.* Bureau of Educational Program Research, Board of Education of the City of New York, October 1958.

Science Corner, an elementary science series of direct teaching lessons over a commercial station. This series was telecast in two sections, one for children in the kindergarten through the second grade and the other for pupils in Grades 3-4. Eight programs were telecast for the children in the lower grades and 7 programs for the pupils in Grades 3-4. An evaluation of each program in the series was conducted. This involved the analysis of questionnaires from 106 teachers in 41 schools who were responsible for the instruction of over 2500 children. These teachers sent weekly reports concerning the effectiveness of the programs in various aspects of pupil learning and also in introducing and implementing a new science course of study. Not only did the results show a substantial increase in the children's science knowledge, but they showed an enthusiastic response from the teachers concerning the way in which television cut across all curriculum areas with the activities and projects.

Our work as teachers really begins when the program is over and the set is turned off. Perhaps a science program holds answers to some questions:

1. Can language arts skills be strengthened by correspondence with the telecaster or people he has mentioned?
2. Can reluctant readers, slow learners, nonconformers, or children with behavior problems be approached through this less conventional avenue?
3. Can a unit be organized based on some discovery of the program? A communication project would have more meaning after a program showing the workings of an electro-magnet.
4. What kind of cumulative record can be kept in connection with the program.
5. How can a teacher learn new demonstration techniques by watching the television performer?
6. How can the teacher utilize the program to develop and explore the science interests of his pupils?
7. How can television stimulate pupils to experiment, to participate in science fairs, and to take trips and go on outings in the interest of science learning?
8. How can television programs serve to encourage the individual child to explore his immediate environment in search of answers to his science questions?

In a recent survey[3] of educational television activities of eleven major cities, including Detroit, Pittsburgh, Chicago, Milwaukee, and Miami, another important contribution of television was found to be that it brought forth home study.

How can we make full use of television in and out of school? The networks are offering a wide variety of programs rich in content and experimentation. Magazines like *Scholastic* publish weekly "Teleguides" featuring the best programs of the week; program guides are frequently given with complete lesson plans for their utilization. This is especially true of *The Bell Science Series, Adventure,* and other science-oriented programs.

In addition, kinescoped recordings of outstanding commercial and educational programs are available through the Educational Television and Radio Center located on Washtenaw Avenue, Ann Arbor, Michigan. Their catalogue will be sent you upon request. To receive their films you need only pay the mailing charges. By organizing out of school viewing, we can carry the school into the home and add another dimension to our teaching.

Enlightened educators and laymen do not believe that television sets will replace teachers. But they do believe that television will grow in importance as one of the most important audio-visual aids to teachers. As with any tool, however, television cannot be truly effective unless the teacher plans for its use, is alert to utilize it to its fullest potential, and wisely follows up its leads and suggestions.

[3] Maurice U. Ames. *A Survey of Educational Television.* Fund for the Advancement of Education, 477 Madison Avenue, New York 22, N.Y.

McCURDY . . . from page 369

These are the only ends that make sense of our search to turn more commonplace and abundant materials into resources. Failure to achieve one or both of these will ultimately send us back to a primitive life. They are:

1. Man does enough research, and builds enough facilities so that he can survive on nothing but air, sunlight, seawater, and common rock.
2. Man does enough research and builds enough facilities to explore and develop other planets.

Our present knowledge does not rule out either of these possibilities. Personally, I draw greater inspiration from the second, and I am certain that the great majority of our young people would too. Fortunately, however, we do not have to choose between these two goals now, for the path ahead in either case is the same—one of ample research.

Some may ask why pursue this long and rocky path at all? Why devote so much time to research? Why not just discover what we have to, in order to keep going comfortably and happily?

Currently, one answer involves national defense. However, irrespective of this, the answer is still clear. The more basic answer concerns "brainpower," the resource that probably will be the critical factor in our attaining either of these goals. Consider the potential rewards of intensifying the development of our scientific brainpower, and advancing scientifically toward putting more and more of the common, abundant, and low-grade materials to good use. First, we probably could support a great many more people and yield more brainpower in the process. Second, we would arrive at such advanced levels before our high-grade materials are consumed to any great degree.

If, however, we continue to consume these resources, without an adequate research program, then one day our stockpile may become too small to make the effort. The diversion of manpower needed in an adequate long range research program may possibly require a fairly liberal expenditure of these many resources.

These then are some of the concepts and goals that have to be given meaning in the minds of the public. For, unless the public learns to understand and appreciate these things, it will be unable to evaluate the need for research or the course it should pursue. The size of the educational program we face was illustrated in a recent survey: only ten per cent of the population could name two living scientists, and each of them had been in the news recently enough to be recalled.

How can we best present research? One way is to frame it in a concept that is truly a part of our heritage. That concept is exploration.

When we talk about exploring, people do not conjure up images of mad explorers. In fact, they recognize the various kinds of explorers; those who explore for the pure joy of discovery (they admire and perhaps envy these adventurers); and their image of commercial explorers is an agreeable one, right from the sourdough through to modern corporation exploration parties. By describing research in this light we might make an unfamiliar thing have reality.

If you feel that this smacks of foxy salesmanship and hidden persuaders, I will not wholly disagree with you, but I ask you to remember two things—first, the analogy does make sense, and second, we are talking about selling an idea as effectively as we can, in a minimum of time.

The public also recognizes the gamble and the code of exploration, which they gained, no doubt, from our western history. From the stories of the sourdoughs they recognize principles that are true also of research: that if people are going to find things, they have to spend a lot of time looking; that a search often comes to nothing; that, when a strike is made, it is fitting for a law man to protect the prospector against claim jumpers. There is nothing in these ideas that has a false ring when applied to commercial research. Neither is there anything greatly different in principle between the boy who explores the woods to see what may be there, and the true natural philosopher. I cannot believe we are doing anybody a disservice by pointing this out.

RICHARD CLARK McCURDY, president of Shell Chemical Corporation, began his career in the petroleum industry in 1933 after graduation in engineering from Stanford University. He has served in offices in Washington, D. C., the West Coast, and Venezuela. In 1953, Mr. McCurdy assumed the responsibilities of his present position. In addition, he is a director of Shell Oil Company, and vice president and director of the Manufacturing Chemists' Association, and a director of the Shell Companies Foundation, Inc., which sponsors many educational activities. He pursues an avid interest in astronomy, electronics and science education.

CONVENTION NOTES


Harold E. Tannenbaum

● ELEMENTARY WORKSHOPS

Elementary science teachers who attend the Convention at Atlantic City on March 31-April 4, 1959 may register for a five-session workshop now being organized by Dr. Harold E. Tannenbaum, Elementary Science Educator at the State University Teachers College, New Paltz, New York. Sessions are being set up for Thursday, Friday, and Saturday of the Convention week.

To head the various sections of the workshop, Dr. Tannenbaum has lined up a talented staff of specialists including Dr. Ned E. Bingham, Professor of Science Education, University of Florida; Dr. Paul E. Blackwood, Specialist for Elementary Science, U. S. Office of Education; Dr. Willard J. Jacobson, Associate Professor of Natural Sciences, Teachers College, Columbia University; Dr. Harry Milgrom, Supervisor of Elementary Science, New York City Public Schools; Dr. J. Hervey Shutts, Consultant in Science, Minneapolis Public Schools; Dr. Dorothy Alfke, Associate Professor of Education, Pennsylvania State University; and Dr. Joseph Zafforoni, Assistant Professor of Elementary Education, the University of Nebraska.

Three of the five sessions will be devoted to practical aspects of the science program carried on in elementary school classrooms. The participants will work directly with science materials related to plant growth, simple machines, current electricity, transportation, and other topics appropriate for elementary school science. With five sub-sections being set up for each work session, the individual groups will be limited to a convenient working size of 20 teachers. There will be two general sessions for the entire group of 100 participants, the first on Thursday at 10 a.m. for the purpose of orientation and the other on Saturday at 3 p.m., when a panel of observers and participants will summarize and evaluate the workshop and offer recommendations.

An advance registration fee of $2.50 will be required to cover the cost of supplies for the workshop activities. This fee should be sent along with other payments when teachers preregister for the convention as a whole.

Further details about the workshop activities will appear in the convention program or may be learned by writing directly to Director Tannenbaum at his home address: 6 Lincoln Place, New Paltz, New York.


Hugh Allen, Jr.


Harry Young

● LOCAL COMMITTEES

A meeting of the heads of local convention committees was called by co-chairmen Hugh Allen and Harry Young in Atlantic City on Friday, September 12 at the Ambassador Hotel. At this meeting Dr. Alfred Saseen, Superintendent of the Atlantic City Public Schools, was named General Coordinator of the Local Arrangements Committee. Dr. Saseen, who has had more experience with conventions than any other superintendent in the country, gave numerous practical suggestions. A list of local committee chairmen is included for the convenience of convention participants who may wish to contact them about any particular arrangements *(see next page)*.


Alfred Saseen

REGISTRATION

Co-chairmen: Anna Flanagan, Science Dept., Westside High School, Newark, N. J.; Mary Oberholtzer, Director of Vocational and Adult Education, Illinois Avenue School, Atlantic City, N. J.

Vice-chairman: Jacqueline Roddy, Science Dept., Long Branch High School, N. J.

HOSPITALITY AND INFORMATION

Co-chairmen: Mrs. Florence Seward, Science Dept., West Orange H. S., N. J.; Miss Elizabeth Vance, Principal, Madison Ave. School, Atlantic City, N. J.

MUSIC AND ENTERTAINMENT

Chairman: Mr. Robert Heath, Music Department, Atlantic City H. S., N. J.

Vice-chairman: Mr. John Bankert, Science Dept., Atlantic City H. S., N.J.

PRODUCTION AND SIGNS

Co-chairmen: Mr. Luke Heath, Art Dept., Atlantic City High School, N. J.; Mr. Don Balsley, Printing Dept., Atlantic City High School, Illinois Ave. School, Atlantic City, N. J.

MEAL FUNCTIONS

Co-chairmen: Miss Mazie Scanlan, Supervisor Elementary Physical Education, School Administration Building, Atlantic City, N. J.; Mrs. Ann Ketterer, Science Dept., Mountain Lakes High School, Mountain Lakes, N. J.

Vice-chairman: Mr. William Davidson, Pres., New Jersey Science Teachers Assn., Thomas Jefferson High School, Elizabeth, New Jersey.

AUDIO-VISUAL

Chairman: Harry A. Young, Chairman, Science Dept., Atlantic City, H. S., N. J.

Vice-chairman: Mr. James Usry, Principal, Indiana Ave. School, Atlantic City, N. J.

PUBLICITY AND PROMOTION

Chairman: Rev. Lucien Donnelly, Science Dept., Delbarton School, Morristown, New Jersey.

Vice-chairman: Miss Marion Johnston, English Dept., Atlantic City High School.

ROOMS AND FACILITIES

Chairman: Mr. Samuel Gillingham, Principal, Atlantic City High School, N. J.

Vice-chairman: Mr. Ralph Truitt, Supervisor, School Administration Building, Atlantic City, New Jersey.

EXHIBITS

Co-chairmen: Mr. Art Taylor, North Plainfield High School Science Dept., North Plainfield, N. J.; Mr. Maitland Simmons, Science Dept., Irvington High School, Irvington, New Jersey.

Vice-chairman: Mr. George Sweeney, Supervisor, School Administration Building, Atlantic City, N. J.

DEMONSTRATION LESSONS

Co-chairmen: Miss Eleanor Helfrich, Supervisor Junior High Schools, School Administration Building, Atlantic City, N. J.; Miss Mary Ferguson, Supervisor Elementary Grades, School Administration Building, Atlantic City, N. J.

An Orientation Exercise in Chemistry

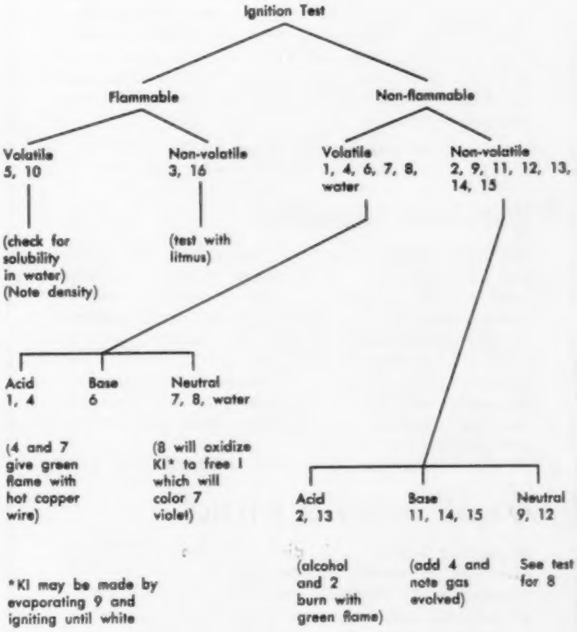
By ROMAN R. CARR
Minnesota Department of Health

and CLARENCE H. BOECK
University of Minnesota High School, Minneapolis

THE introduction to chemistry can be made very interesting by using an approach based on analysis and organization of matter. Identification procedures are often used in other science courses to add interest to the laboratory work. Mineralogy would probably be dull to most students if it were not for the time spent in identifying rocks. The classification of plants and animals in biology makes it possible to have interesting field trips. The classification and identification of matter is an important aspect of chemistry which can be used advantageously either as an introduction to the chemistry course or as a part of general science. The ordinary chemicals found in and about the household can be used as unknowns to be identified. One can begin by letting the students themselves suggest most of the items, such as, salt, sugar, bleach, iodine, and soda. Most pupils are familiar with these, at least by name, but do not ordinarily think of them as chemicals. Their properties could be discussed and the materials could be grouped according to their properties as a basis for their ultimate identification. Here is a means of instruction based on purposeful activity which might well take the place of a routine of seemingly unrelated tasks. This procedure is to be used with unknowns containing a single substance. This has an advantage in that no separations are involved. This eliminates many difficulties in technique.

The following schematic diagram may be used as a guide:

1. Acid, Acetic	(vinegar)
2. Acid, Boric	(eye wash)
3. Acid, Citric	(citrus fruit acid)
4. Acid, Hydrochloric	(muriatic acid)
5. Alcohol, methyl or isopropyl	(antifreeze, rubbing compound)
6. Ammonia water	(cleaning agent)
7. Carbon Tetrachloride	(fire extinguisher)
8. Hydrogen Peroxide	(hair bleach, antiseptic)
9. Iodine Solution	(antiseptic)
10. Kerosene	(fuel)
11. Sodium Carbonate	(washing soda)
12. Sodium Chloride	(common salt)
13. Sodium Hydrogen Sulfate	(bowl cleaner)
14. Sodium Hydroxide	(lye)
15. Sodium Hypochlorite	(bleach)
16. Sugar Solution	



A first demonstration might be the differentiation of a salt solution from a sugar solution by means of a simple ignition test using a few drops on a spatula. The latter may be improvised from clothespins and pieces of stainless steel scraps. Here it could be explained how all matter is divided into two main classes, organic and inorganic. Indicator

paper can be used to show how these in turn can be broken down into acids, bases and neutral compounds. Other tests might be demonstrated to show further classification of matter.

After this brief orientation the students should be told that they will receive solutions of these chemicals as unknowns and their identification will be required. At once student objectives become very clear. They are presented with a fair challenge because in solution form most of these chemicals look alike and, of course, no one should depend solely on taste and odor properties because among these common items there are some strong acids and bases which should be handled with caution. Often the students are ready to plunge into the laboratory work in the second or third period.

The preparation of the equipment and solutions [1] should be taken up first. If the students are allowed to help they gain needed familiarity. No reagents beyond those usually found in a junior high school are required: indicator paper, copper wire, a few test tubes and spatulas, are the only other necessary starting materials.

[1] Roman Carr. "An Ampule Reagent Rack for Semi-Micro Chemistry." *The Science Teacher*, 23:357. November 1956.

Going through several of the unknowns in the manner suggested in the schematic diagram can actually be fun for the students. Each of the steps introduces a new concept in chemistry in such a way that they feel they knew it all the time. Furthermore, they get a feeling of accomplishment which may be likened to the music student playing his first tune. While certain of these steps in analysis appear to have flaws, they may be turned to advantage in teaching the need for precautions in observation, recording of data, and interpretation of results. For example, many students are puzzled when determining if a residue remains after ignition. Boric acid solution produces a very small amount because of its low solubility. Hydrochloric acid, on the other hand, due to its corrosive action often produces what appears to be a residue but in reality is not. This is an ideal place to stress the need for care and for carrying out further confirmatory tests as soon as possible.

Other Experiments

As the class gains some confidence some other common materials may be introduced and fitted into the procedure. Some suggestions are as follows: aspirin, epsom salts, gasoline, gelatin, glycols, glycerine, lime, soap, starch, syrup and vegetable oil. (Other acids involving greater hazards in handling should be demonstrated by the teacher.) These may also be given out as unknowns, either in the natural state or in solution form. By developing some of their own differentiating tests such as specific gravity or boiling points their ingenuity is challenged further. This should be encouraged and steered into a healthy pattern of creativeness. No new mysterious reagents should be introduced at this early stage. The whole scheme would lose its purpose if, for example, a convenient reagent like silver nitrate were used. The object is to encourage critical thinking instead of the mere following of cookbook like instructions.

With this kind of introduction the laboratory can be ideally correlated with the class discussions. These naturally lead into such topics as nomenclature, strengths of solutions, neutralization of acids and bases and reaction of metals with acids. When the important question comes up about what quantities of a substance react with one another, it should be clear that this is a critical point. It is here that the general science course ends and chemistry begins. Now the reasons for going into formulas, molecular weights and atomic theory are better understood by the students.

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prevent glare and undesirable heating effects. Tackboard was frequently used as a "filler" between other wall facilities or in corners, rather than being planned as a usable facility. Tackboards were frequently too small, and if placed in the back of the room, are infrequently used. All teachers who have classroom library facilities stated that they were used as an integral part of the classroom activities. Many teachers stated that more area should be given to this item in future planning.

Table VI shows the ratings given by the teachers to facilities which have specific applications to laboratory areas. It is to be noted again that many

Table VI. How Did Teachers Rate Laboratory Facilities?

Item	*Rating: % responding, to nearest 1%* 1	2	3	4	M	*Usable Responses*
a. Space utilization.......	43	38	11	6	2	209
b. Dispensing area for laboratory materials....	26	30	23	8	13	210
c. Preparation area......	38	32	16	6	8	205
d. Amount of individual working space.......	35	36	20	6	3	200
e. Area for "permanent" project "set-ups"....	8	21	22	13	36	211
f. Plant and animal growth areas........	15	18	20	7	2	213
g. Accessibility to student work areas..........	44	38	12	4	2	206
h. Dark Room...........	30	19	6	3	42	211
i. Table surfaces.........	50	34	10	5	2	211
j. Floors................	54	29	11	5	1	211
k. Acoustics.............	49	37	9	3	2	211
l. Chalkboard...........	38	32	16	6	8	204
m. Safety provisions......	32	40	19	5	4	212
n. Fume hoods..........	45	29	12	14	0	138*
o. Gas outlets...........	62	22	6	3	7	210
p. Electricity outlets.....	58	23	9	6	3	210
q. Water outlets.........	54	29	9	5	3	211
r. Drains and waste facilities................	42	23	18	6	5	191
s. Illumination..........	60	30	7	2	1	209

* Junior high schools were not counted in the percentage computation.

items, frequently considered essential, are missing in many new schools. Among these are: (1) a dispensing area for laboratory materials, (2) areas for "permanent" project "set-ups", dark rooms, plant and animal growth centers, and chalkboards.

There were many vigorous comments expressing the desire for more area in which students could work on projects and store the same for extended periods of time. Many teachers of chemistry reported that while fume hoods were present, they frequently were noisy and insufficient. The preparation area was often reported as being a closet-style arrangement with inadequate utilities, ventilation, space, and shelving. Some teachers felt that the laboratory space could have been better utilized through better desk arrangement. Some thought that space was wasted, while others felt that undue economy was exercised in making the aisles too narrow. One teacher reported that students rubbed backs while standing at the laboratory desks.

A study of the comments at the end of the questionnaires indicated that certain facilities are coming into more common use than formerly. Many teachers approved highly of perimeter work benches or permanent laboratory tables at one end of the room with movable furniture in the center of the room. Multipurpose classrooms enabled a variety of activities to be pursued at one time. Many schools are adding greenhouses which will presumably be used for animal growth areas as well as plant growth projects. Vision strips between various segments of the science suite have been found to

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NSTA Activities

News Flash

NSTA has moved promptly to meet new demands and responsibilities that have devolved upon the Association as a result of the National Defense Education Act recently enacted.

A work-conference to develop plans and begin manuscript production for a series of bulletins on various aspects of facilities for use in science teaching was held in Washington, D. C., October 28-29. The committee named by President Herbert A. Smith to carry on the project includes representation of science teachers, supervisors, state departments of education, school administrators, and teacher education. Scientists representative of biology, chemistry, physics, and the earth sciences, will serve as consultants to the committee.

As bulletins are made available by the working committee, school superintendents and state department personnel will be advised promptly. These will be of interest to those with major responsibility for working with teachers and supervisors in the development of criteria and minimum standards for the selection and purchase of equipment and other facilities.

Financing of the project is being arranged through cooperation of the Scientific Apparatus Manufacturers Association. Interested members of SAMA are contributing to an initial fund to help establish the new NSTA service. This phase of operations is being handled by Dr. James Irving, SAMA Director of Public Information and formerly head of the science department in Maine Township, Illinois High School.

Membership Report

Individual memberships have now passed the 11,000 mark. Life memberships have reached a total of almost 450, while sustaining members have increased to about 2000. Individual and group subscriptions now provide for a circulation of nearly 30,000 copies of the *Elementary School Science Bulletin. Tomorrow's Scientists*, the student publication, promises to run far ahead of last year's gratifying total of about 20,000 subscriptions. This is the time of year, however, when it seems important and necessary to remind all members and subscribers to renew orders promptly for 1959 so that interruptions in services and materials will not occur. The more promptly renewals and changes of address are received at the headquarters office, the better the service that we can render. Please bear in mind also that it takes about 4 weeks to process.

Debt Reduction Progress

Over 1400 members of NSTA have contributed a total of nearly $5000 towards reduction of NSTA's indebtedness to the NEA and the development of an NSTA Reserve Fund. The total deficit of $21,000 as of last May 1 has now been reduced by one-third. Long-standing members of NSTA will recall that this indebtedness was gradually accumulated over the first eight years of NSTA operations during which time the Association purchased *The Science Teacher,* and also began development of a publications program. These and other "bootstrap" operations were essential to the growth of a strong and dynamic professional endeavor. The funds needed for these purposes were advanced by the NEA without interest charges. The officers and members of NSTA are delighted with current progress.

CCSSO Conference

Watch for the report of a work conference of the Council of Chief State School Officers, held November 3-5 at Michigan State University. Its purpose, "to develop guidelines for use by state educational agencies in determining standards for science, mathematics, and foreign language equipment under Public Law 85-864, Title 3, Section 303(a)(4)."

The conference group, however, went far beyond this simple assignment. Their discussions compelled them to consider, for example, the goals of instruction, procedures in teaching, and the need for carefully thought out *programs* extending throughout the elementary and secondary schools. It was recognized that equipment and materials "make sense" only when justified by these considerations and can be shown to be essential or useful in implementing a school's science program. The conference report embodying these viewpoints should be ready for distribution by December 1.

Consultants to the sub-committee on science included: Dr. Alfred B. Garrett, Professor of Chemistry, The Ohio State University; Dr. Elmer McDaid, Director of Exact Sciences, Detroit Public Schools; and Mr. Robert H. Carleton, NSTA. Dr. Herbert A. Smith, NSTA President, also participated throughout the conference and was selected to be a co-author of the report. Director of the conference was Dr. John R. Mayor, Director of Education, AAAS. Financing was provided by Educational Facilities Laboratories (sponsored by the Ford Foundation).

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be practical. Several physics rooms are installing multiple power facilities at all laboratory tables. Many schools are designing and building their own furniture. There is a more liberal use of color on walls, floors, and ceilings. Tote trays seem to be more popular. At least six schools reported enthusiastically on the use of semi-micro techniques in chemistry, claiming that this procedure saved time, space and reduced equipment and supplies costs.

What is unique in the way of facilities and equipment for one school may not be for another. However, these are some of the items listed as being unique by various teachers. Two schools reported on patio gardens or rectangular courts (one was 140′ x 50′) where outdoor projects could be pursued. Each court could be reached from any classroom in the science suite. One school has portable laboratory demonstration centers and no permanent demonstration table. One demonstration table has two segments, one of which is portable. One school has a student operated research file in the science library. Several schools reported having meteorological facilities on the school roof. Two schools reported on laboratory facilities (a separate labo-

ratory in one school) for able and advanced classes. Other unique items included:

(a) a garbage disposal unit in the biology preparation room
(b) a hibernation pit in the greenhouse floor
(c) a wall fan and duct in the chemistry laboratory to remove fumes not taken out by the fume hoods
(d) a storage vault for radioactive materials (no details were given)
(e) a corner for a ham radio shack
(f) deep, built-in storage along the walls
(g) a Spitz planetarium
(h) spotlights on the chalkboard

C. SUMMARY

In an effort to determine the effectiveness of science facilities constructed for grades 7-12 between 1953-1958, questionnaires were distributed nationally by the NSTA. 234 returns were analyzed to obtain the following information: (1) The composition of the committee responsible for planning science facilities needs to be enlarged to include more frequently the teachers who will use the facilities as well as members of the administrative staff and the architect. (2) There appears to be a continuation of the trend toward building multipurpose science rooms. (3) In most cases the number of science rooms is adequate for the number of new students taking science. (4) Approximately 26% of the schools studied had less than 35 sq. ft. of area per student, the minimum considered essential for good teaching. (5) Storage areas were below the minimum size in 55% of the schools. (6) Teacher preparations areas and student project or research areas continue to be neglected in school plant planning. (7) The facilites which received the greatest number of undesirable ratings included (a) room darkening facilities, (b) display areas, (c) classroom library facilities (d) office and consultation area, (e) inadequate amount of chalkboard and tackboard, (f) sinks and drains, (g) plant and animal growth areas, and (h) fume hoods. (8) An increase in the number of the following facilities was noted: (a) perimeter work benches, (b) movable furniture, (c) greenhouses, (d) vision strips between various parts of the science suite, and (e) locally constructed furniture. (9) Certain unique facilities as reported by the teachers were noted.

Bibliography

School Facilities for Science Instruction, edited by J. S. Richardson, National Science Teachers Association, 1201 16th Street, N. W., Washington, 6, D. C., 1954.

SCIENCE TEACHING MATERIALS

Prepared by NSTA Teaching Materials Review Committee
Dr. Robert A. Bullington, *Chairman*, DeKalb, Illinois

BOOK BRIEFS

SIR ISAAC NEWTON'S PAPERS AND LETTERS ON NATURAL PHILOSOPHY. Edited by I. Bernard Cohen, assisted by Robert E. Schofield. 501p. $12.50. Harvard University Press, Cambridge, Mass. 1958.

The actual texts of Newton's papers other than the *Principia* and *Optiks* are photographically reproduced. The editor has included the first biography of Newton and introductions to various sections by modern experts. The book reveals the thoughts of Newton and important contemporaries. Of considerable value to the student of the history of science and of interest to teachers of physics.

LABORATORY OUTLINE FOR GENERAL ZOOLOGY. George Edwin Potter. $3.60. C. V. Mosby Co., St. Louis, Missouri. 1958.

A revision of an old standard. All pages perforated for removal, outlines of many drawings. A satisfactory manual for the instructor who plans to use this particular set of organisms in his course.

BRITISH MAMMALS. Maurice Burton, 64p. $2.75. Oxford University Press, New York. 1958.

Contains much general information about the ways of British mammals and is written for reading comprehension of upper elementary and secondary levels. General enough to be applicable to North American mammals, as well as those of England.

THE WEATHER WORKBOOK. Fred W. Decker. 19p. Plus charts and maps. $1.60. The Weather Workbook Company, 827 N. 31st Street, Corvallis, Oregon. 1958.

This workbook is designed for a college course in elementary meteorology. Much thought has gone into the construction of this highly useful manual. It may be used with any textbook in basic meteorology.

ANATOMIST AT LARGE. George W. Corner. 215p. $4.00. Basic Books, Inc., 59 4th Ave., New York 3, N. Y. 1958.

The first one-third of this book is an autobiographical account by a foremost anatomist and historian. The remaining two-thirds of the book is devoted to ten selected essays published between 1915 and 1957. These cover a wide variety of medical topics. Although there is considerable range in the quality of the essays, all are very readable. Suitable for high school use.

LIVES IN SCIENCE. A Scientific American Book. 274p. $1.45. Simon and Schuster, Inc., Rockefeller Center, New York 20, N. Y. 1957.

This paper-bound volume includes eighteen biographies of famous scientists originally published in *Scientific American* between 1948 and 1957. Part of a series of ten volumes, all of value and interest to the science student or teacher and for the library.

HOW TO TEACH IN THE ELEMENTARY SCHOOL. Bernard C. Kelner. 343p. $5.50. McGraw-Hill Book Co., New York. 1958.

A book of definite value to (1) the student preparing to teach, (2) the beginning teacher needing help, (3) the return-to-service teacher, and (4) the veteran teacher seeking to improve his service. Written by an experienced teached and administrator, it answers many of the problems peculiar to the elementary school. Each chapter seeks to enlighten the reader on a specific point of interest. Brief and to the point.

THE STARS: STEPPING STONES INTO SPACE. Irving Adler. 125p. 35c. New American Library, 501 Madison Ave., New York 22, N. Y. 1958.

This Signet Key booklet is superior for most readers in astronomy because of the accurate simplification of astronomical statements. Arranged in a logical sequence of learning experiences. It gives a scientific explanation of the star constellations and a brief statement of their legendary implications, tying these literary ideas to the valid statements of astronomical significance. An invaluable aid to the teacher of science units in the elementary schools.

ORBIT. Hy Ruchlis. 147p. $2.75. Harper & Brothers, New York. 1958.

A book showing the relationship of inertia and gravity to space travel. Concepts made clear by comparison to many simple examples. Covers the laws of Newton in relationship to space travel. Well illustrated and easily understood.

THE WORLD OF CARBON. Isaac Asimov. 178p. $2.75. Abelard-Schuman, 404 Fourth Ave., New York 16, N. Y. 1958.

This book is the first of two covering the field of organic chemistry. It describes the relationship of organic chemistry to daily living in an entertaining manner, and on a level easily understood by the high school student or layman.

AMERICA'S NATURAL RESOURCES. Edited for the Natural Resources Council of America by Charles H. Callison. 211p. $3.75. The Ronald Press Company, New York. 1958.

Eleven of the nation's leading authorities on conservation summarize the facts about our natural resources and their conservation, each in a separate chapter. Here we find basic information on the present status of soil, water, grasslands, forests, wildlife, fish, and wilderness areas. A readable report of value to teachers interested.

MEN AND WOMEN BEHIND THE ATOM. Sarah R. Riedman. 228p. $3.00. Abelard-Schuman, Inc., New York. 1958.

From the Curies to Oppenheimer, the men and women famous for atomic research are portrayed from childhood to great achievement. An interesting and understandable biography for inspirational reading and book reports by high school students.

PRINCIPLES OF RESEARCH IN BIOLOGY AND MEDICINE. Dwight J. Ingle. 123p. $4.75. J. B. Lippincott Company, Philadelphia, Pa. 1958.

A wealth of information is incorporated in this didactic little book. The author, a practicing research scientist, has done an excellent job of organizing the material. Advanced undergraduates or graduates interested in research will find it profitable reading.

PROFESSIONAL READING

"The Conservation of Intellectual Talent." By Donald L. Thistlewaite. *Science*, 128:822-6; October 16, 1958. Summary and discussion of studies relating to the reasons why some able students do not attend college and the role of scholarships in reducing talent loss.

"Individual Creativity in Research." By Lewis E. Walkup. *Battelle Technical Review*, August 1958. There is need to understand better the techniques of creativity. The author firmly believes that most persons can improve their creativity quotient, offers suggestions for improving individual creative qualities.

Improving Science Programs in Illinois School. 88p. 25 cents. 1958. Office of Field Services, 309 Gregory Hall, University of Illinois, Urbana, Illinois. Analysis and recommendations of a joint committee. Part I, Science Education in the Present Crisis; Part II, Science Education: Appraisal and Recommendations; Part III, Recruitment and Preparation of Teachers.

"Atomic Energy Concepts of Children in Third and Sixth Grade." By Doris Young. *School Science and Mathematics*, 58:535; October 1958. Grade school children develop atomic energy concepts through out-of-school as well as in-school experiences.

"What Kind and Amount of Help Do Our Beginning Teachers Need?" By Edward Victor. *School Science and Mathematics*, 58:550; October 1958. Makes the point that unqualified science teachers and beginning qualified teachers need different types of assistance, the former in manipulating equipment, the latter in increasing their teaching effectiveness.

Selected Science Books for Secondary Schools. (A Bibliography.) 116p. 25c. 1958. Compiled by a committee of the Connecticut Science Teachers Association. Order from R. Vincent Cash, Teachers College of Connecticut, New Britain, Connecticut. An extensive annotated list of science books for high schools.

"Science and the Social Studies." By Glenn O. Blough. *The National Elementary Principal*, 37:15; May 1958. The contributions of science and the social studies are complementary to each other. In studying certain problems in the elementary school, fusion of these two fields would be desirable, in others undesirable.

Television in Instruction: An Appraisal. 24p. $1.00. Department of Audio-Visual Instruction, National Education Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Report of Seminar on the role of television instruction.

APPARATUS AND EQUIPMENT

DISTILLATION AND PETROLEUM KIT. This is a 3 color, non-consumable kit for use in grades 4 through 9. It is 16" x 9" x 2" complete with a protective cover. Includes samples of petroleum products, showing how they are made by distillation. Will serve to develop a science interest with related learnings in chemistry, physics, earth science, and conservation. $8.50. Models of Industry, Inc., 2100 Fifth Street, Berkeley, California.

HAMMOND'S GUIDE TO THE EXPLORATION OF SPACE. A poster containing educational comparisons involving solar system planetary data, artificial satellites, space travel vehicles, and man's probable reaction to differing "gravity" values for the planets. These comparisons are semi-quantitative and easily understood. The chart-poster is well done from an artistic viewpoint. $1.00. C. S. Hammond and Company, Maplewood, New Jersey.

HOME GARDENS. A free folder on gardening by school children. Distributed by makers of greenhouses for school use. These greenhouses may be added at the side of existing buildings or to the roof. Aluminum Greenhouses, Inc., Cleveland 11, Ohio.

PLANNING MANUAL FOR EDUCATIONAL SCIENCE LABORATORIES. 76p. Free. Kewaunee Manufacturing Company, Adrian, Michigan. 1959.

A catalog which includes analysis of activities conducted in secondary school science classrooms, floor plan drawings with equipment lists, elevation drawings of equipment, and mechanical service with rough drawings for each item. Very useful for planning new or remodeled laboratories.

OHAUS CENTOGRAM BALANCE. A reasonably sturdy triple beam balance with a capacity of 311 grams. It has a sensitivity of 1/100 gram. Designed for chemistry, physics, and biology work where a high degree of precision is not required. Easy to use. $29.50. Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J.

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NATIONAL SCIENCE FOUNDATION GRANTS

The National Science Foundation has announced grants totalling over $8,600,000 to 32 colleges and universities in support of Academic-Year Institutes designed to help high school science and mathematics teachers improve their subject matter knowledge.

The institutions receiving grants and the directors of each Institute are listed below. *Applications by high school teachers for acceptance in the Institutes should be sent to the directors.* All selections will be made by the host institution. Do NOT write to the National Science Foundation or to NSTA.

INSTITUTIONS RECEIVING GRANTS FOR ACADEMIC-YEAR INSTITUTES, 1959-1960

Mathematics Only

BOSTON COLLEGE—Rev. S. Bezuszka, S. J., Department of Mathematics, Chestnut Hill 67, Massachusetts.

ILLINOIS, UNIVERSITY OF—Prof. J. Landin, Department of Mathematics, Urbana, Illinois.

KANSAS, UNIVERSITY OF—Prof. G. B. Price, Department of Mathematics, Lawrence, Kansas.

LOUISIANA STATE UNIVERSITY—Prof. H. T. Karnes, Department of Mathematics, University Station, Baton Rouge 3, Louisiana.

MINNESOTA, UNIVERSITY OF—Prof. C. Hatfield, Department of Mathematics, S. L. A., 119 Folwell Hall, Minneapolis, Minnesota.

NOTRE DAME, UNIVERSITY OF—Prof. A. E. Ross, Department of Mathematics, Notre Dame, Indiana

SAN DIEGO STATE COLLEGE—Prof. J. E. Eagle, Mathematics Department, San Diego 15, California

General Programs in the Sciences and Mathematics

ARIZONA STATE COLLEGE—Prof. A. T. Wager, Department of Physics, Tempe, Arizona.

ATLANTA UNIVERSITY—Prof. K. A. Huggins, Department of Chemistry, Atlanta 14, Georgia.

BROWN UNIVERSITY—Prof. E. R. Smith, Department of Education, 71 Brown Street, Providence 12, Rhode Island.

COLORADO, UNIVERSITY OF—Prof. W. E. Briggs, Department of Mathematics, Hellems Annex 318, Boulder, Colorado.

GEORGIA, UNIVERSITY OF—Prof. J. J. Westfall, Department of Botany, Athens, Georgia.

HARVARD UNIVERSITY—Prof. E. C. Kemble, Department of Physics, Lyman Laboratory, Cambridge 38, Massachusetts.

HAWAII, UNIVERSITY OF—Prof. J. J. Naughton, Department of Chemistry, Honolulu 14, Hawaii.

IOWA STATE TEACHERS COLLEGE—Prof. R. A. Rogers, Department of Science (Physics), Cedar Falls, Iowa.

MICHIGAN, UNIVERSITY OF—Prof. F. D. Miller, Department of Astronomy, 1018 Angell Hall, Ann Arbor, Michigan.

NEW MEXICO, UNIVERSITY OF—Prof. W. Ivins, Department of Secondary Education, College of Education, Albuquerque, New Mexico.

NORTH CAROLINA, UNIVERSITY OF—Prof. E. C. Markham, Department of Chemistry, 210 Venable Hall, Chapel Hill, North Carolina.

NORTH DAKOTA, UNIVERSITY OF—Prof. J. D. Henderson, Department of Physics, Grand Forks, North Dakota.

OHIO STATE UNIVERSITY—Prof. J. S. Richardson, Department of Education, 250 Arps Hall, Columbus 10, Ohio.

OKLAHOMA STATE UNIVERSITY—Prof. J. H. Zant, Department of Mathematics, Stillwater, Oklahoma.

OREGON STATE COLLEGE—Prof. S. E. Williamson, Department of Science Education, Corvallis, Oregon.

PENNSYLVANIA STATE UNIVERSITY—Prof. W. H. Powers, Department of Chemistry, 102 Sparks Building, University Park, Pennsylvania.

PENNSYLVANIA, UNIVERSITY OF—Dean W. E. Arnold, School of Education, Philadelphia 4, Pennsylvania.

SOUTH DAKOTA, STATE UNIVERSITY OF—Prof. C. M. Vaughan, Department of Zoology, Medicine and Science Building, Vermillion, South Dakota.

SYRACUSE UNIVERSITY—Prof. A. T. Collette, Department of Bacteriology and Botany, 400 Lyman Hall, Syracuse 10, New York.

TEXAS, UNIVERSITY OF—Prof. R. C. Anderson, Department of Chemistry, Austin, Texas.

TUSKEGEE INSTITUTE—Prof. W. E. Belton, Department of Chemistry, Tuskegee Institute, Alabama.

UTAH UNIVERSITY OF—Prof. T. J. Parmley, Room 215, Physical Science Building, Salt Lake City 12, Utah.

VIRGINIA, UNIVERSITY OF—Prof. J. W. Cole, Jr., Department of Chemistry, Charlottesville, Virginia.

WASHINGTON UNIVERSITY—Prof. E. U. Condon, Physics Department, St. Louis 5, Missouri.

WISCONSIN, UNIVERSITY OF—Prof. D. H. Bucklin, Department of Zoology, Madison, Wisconsin.

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three of biology, chemistry, and physics. The quintile rankings are sent to the schools, and approximately 100 survivors are interviewed on the last Saturday of January. In June a banquet is held for some thirty award and thirty honorable mention winners. Prizes include partial tuition grants, many other material prizes, certificates, summer jobs in science, and assistance in securing scholarships.

The mayor of Houston, Texas, recently presented in a public ceremony, certificates and savings bonds to local high school "star" science students.

Other Teaching Aids

Many commercial laboratories are making their own facilities available for high school teaching, and have been loaning or giving equipment and supplies. Recently in Yonkers, New York, $3000 worth of electronic equipment was given away for use in constructing science projects. High school students from a radius of many miles benefited. The Highland Park, New Jersey High School has been receiving gifts and loans of special supplies and equipment from nearby laboratories. Industries and public utilities in the North Haven, Connecticut area, frequently loan exhibits and displays to the high school. The advisory committee of scientists cooperating with the Pitman, New Jersey High School, besides securing gifts of equipment from local corporations, has helped to inventory and repair school science equipment.

Visits to industry and commercial laboratories for observation and study by science teachers and students, are rapidly growing practices. The "BE" (Business Education) Day is common, and shows in general an intelligent and effective relationship between industry and schools. Students at the Highland Park, New Jersey High School are released to spend a day at a time alone with a scientist at work, in order to gain the experience of a day on the job. Instances are reported of teachers making observational visits of days or weeks for close study of procedures and projects in industrial laboratories. Recently the United Aircraft Corporation provided the financial support for a Nuclear Science Institute involving over 200 persons at the North Haven, Connecticut High School.

There are many community speakers' bureaus of local scientists offering services for specialized science lectures and demonstrations, for assistance on research projects, and for career conferences. The ACS has taken the initiative in matters of this sort in many places, but numerous other local industries and professional groups have also been active. Manhasset, New York, has a "Community Resources File" available to the schools as a guide for community help with human and national resources. The Baltimore, Maryland Public Schools have both a biological and physical science resources committee for the same purpose.

Professional scientists have in some communities been assisting the schools in curriculum development and revision. The North Haven, Connecticut High School recently evaluated its physical science instruction, aided by a committee of citizens. Local scientists and other lay persons are consulted in Fairfield, Connecticut for suggestion to improve the science curriculum.

Conclusion

These descriptions of community activities in science education are sketches based upon information [3] that came to the writer's notice. No attempt was made to make an ordered or systematic sampling of any kind, nor was geographical representation adequate. Actually, developments are so rapid that any cataloging is out-of-date even while being prepared. It is hoped however that some of the ideas and information can be useful to those seeking to amplify and diversify the science teaching in their own neighborhoods.

Many foundations and other nationwide agencies are at the disposal of even the smallest communities. These can never replace local efforts that marshal neighborhood personnel and resources. Such activities not only make for better teaching, but also stimulate the understanding and spirit of participation by everyone in the community in the complex exigencies of science education.

[3] Acknowledgment is made of the many persons who provided materials and suggestions in these areas.

Geography Test Materials Wanted

The Committee on Tests, National Council of Geographic Education is compiling a handbook on *Measurement and Evaluation in Geography*. Please send samples of complete tests or individual questions at all grade levels from elementary through college to use as illustrative material for the handbook to Berenice M. Casper, Chairman, at 2632 "K" Street, Lincoln 10, Nebraska. Send subjective and objective material, either written or oral, testing skills, attitudes, and appreciations, as well as subject matter. Please designate grade level on all items.

HECTOR SAYS: While browsing through the publications, two new ones were delivered and are listed for you.

1. *Encouraging Future Scientists: Student Projects.* By John H. Woodburn. Revised Edition. Gives suggestions and ideas for projects; discusses 14 classes or categories of projects high school students can do; offers advice or "tips" on how to start, design experiments, and write up and present a scientific project. Includes abstracts of 42 science projects which have won awards or honorable mention in the FSAF program of SAA sponsored by the American Society for Metals. 20p. 50¢.

2. *Conference Reports:* "Teacher Demonstrations in Chemistry," "The Science Teacher as Career Counselor," and "Teaching Critical Thinking Through Chemistry." Suggestions and recommendations developed by teams of experienced high school teachers in three conferences held by NSTA's Future Scientists of America Foundation during the summer of 1957. 32p. $1.

AUDIO-VISUAL AIDS

PREHISTORIC ANIMALS OF THE TAR PITS: *The Story of Rancho La Brea.* Recommended for elementary and junior high science but also useful at the high school and college levels. The role of fossils in establishing the characteristics of prehistoric animals is demonstrated by the excavations from the La Brea tar pits in Los Angeles, California. Includes information on the manner of entrapment, methods of excavation, preparation of skeletal mounts, and the reconstruction of the animals. 14 min. Color $125, B&W $62.50. 1958. Film Associates of California, 10521 Santa Monica Boulevard, Los Angeles 25, Calif.

ELECTRICITY ALL ABOUT US. Explores the topic of electricity, emphasizing the elementary aspects of static and current electricity. Very suitable for elementary grades. 11 min. Color $100, B&W $55. 1958. Coronet Films, Coronet Building, Chicago 1, Illinois.

MICROORGANISMS: BENEFICIAL ACTIVITIES. Emphasizes the beneficial aspects of bacteria, yeasts, and molds. Good coverage of all aspects of the nitrogen cycle. Shown is the role of microorganisms in the production of dairy products, antibiotics, alcohol, acids, silage, and bread. Sewage treatment briefly shown. 15 min. Color $150, B&W $75. 1958. Audio-Visual Center, Indiana University, Bloomington, Indiana.

BACTERIA: LABORATORY STUDY. A complete story of standard laboratory techniques for the culture and study of bacteria. Covers medium preparation, sterilization, inoculation, incubation, isolation, colony characteristcs, cell features, metabolism, and methods of destroying bacteria. Excellent photography and narration. Highly useful in any high school or college biology course where bacteria are studied. 15 min. Color $150, B&W $75. 1958. Audio-Visual Center, Indiana University, Bloomington, Ind.

UNDERSTANDING THE PHYSICAL WORLD THROUGH MEASUREMENT. National Bureau of Standards. (Correction, sale price $107.90 instead of $14.43 as listed October.)

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